TECHNICAL MANUAL

IW703 Infant Warmer Head

IW702 Servo Controller

IW817 Infant Radiant Warmer

IW818 Infant Resuscitation Centre

IW820 Infant Care Centre

Version E

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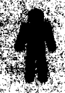
Technical Manual for Infant Warmer Models: IW703 Infant Warmer Head.
IW702 Servo Controller.
IW817 Infant Radiant Warmer.
IW818 Infant Resuscitation Centre.
IW820 Infant Care Centre.

TABLE OF DEFINITIONS AND SYMBOLS

Warnings

- A WARNING statement refers to conditions with a possibility of personal injury if a procedure is not followed exactly.

Symbols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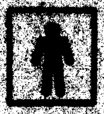
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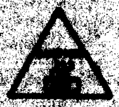
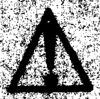

Caution
hot surfaces


Attention - consult accompanying documents

~ Alternating Current

⏚ Protective Earth

○ Off (Power: disconnect from mains)

| On (Power: connect to mains)

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Changes To Technical Manual Since Last Version

Description of Change	Page Numbers Affected
Add resistor R47 and capacitor C16 to IW703 J models only.	18,21,35

1.0 General Specifications.

This documentation defines the technical specifications of the IW703 Infant Warmer Head, and the IW702 Servo Controller.

1.1 IW703 Infant Warmer Head.

As fitted to an IW817, IW818, or IW820 Infant Warmer.

The IW703 Infant Warmer Head provides manual control of the 600W radiant heater power.

1.1.1 Product Specifications.

Catalogue number:	IW703
Dimensions:	Height 107mm Width 390mm Depth 760mm Weight 13kg
Supply voltage:	230V ± 20V ~ 115V ± 15V ~
Supply current:	3.0 A maximum at 230V 6.0 A maximum at 115V
Supply frequency:	50 / 60 Hz
Heater Capacity:	600W
Lights:	26W

1.1.2 Operating Instructions.

INSTALLATION

1. **General.**

The unit must be firmly and securely located to its mounting surface at all times, so that the minimum distance from the infant is maintained with no decrease being possible, either deliberately, by accident, or by misuse of any kind.

For attachment, please refer IW817/IW818/IW820 assembly instructions.

2. **Power.**

Ensure that power supply is the same as that specified on the unit. Plug the power cord into power supply. Ensure the power cord is not a hazard to staff and patients.

OPERATION

1. **When fitted with an IW702 Servo Controller (optional accessory to IW703 Infant Warmer Head).**

   i. Switch on power by depressing the POWER button.

   ii. Switch on lights, if required, by depressing the LIGHTS button.

   iii. The warmer will automatically start operating in SERVO mode. For operating instructions in SERVO mode refer to section 'IW702 Servo Controller - Operation' (page 3).

iv. Operating in MANUAL mode. If manual control is required, to pre-heat the heater for example, then it must be selected by depressing the HEAT MODE button to MANUAL mode.

v. Check that the MANUAL mode light on both the IW703 Infant Warmer Head and the IW702 Servo Controller are illuminated.

vi. Preheat for ten minutes with the HEAT CONTROL knob set to 10.

vii. Select desired heat setting, between 1-10, and allow the unit to reach a stable operating temperature.

viii. Place the infant in the crib.

ix. When operating the warmer in MANUAL mode, it is important to ensure that the infant's temperature is constantly monitored. It is possible to use the IW702 Servo Controller simply as a temperature monitor. See section 'IW702 Servo Controller - Operation' (page 3).

Warnings

If the IW702 Servo Controller is not fitted to the IW703 Infant Warmer Head, the infant's skin temperature should be monitored continuously using an external temperature monitor. We recommend the use of the Fisher & Paykel TM101 Temperature Monitor.

2. When not fitted with an IW702 Servo Controller.

i. Switch on power by depressing the POWER button.

ii. Switch on lights, if required, by depressing the LIGHTS button.

iii. Switch on heat by depressing the HEAT MODE button.

iv. Preheat for ten minutes with the HEAT CONTROL knob set to 10.

v. Select desired heat setting between 1-10, and allow the unit to reach a stable operating temperature.

vi. Place the infant in the crib.

vii. We recommend use of the Fisher & Paykel TM101 temperature monitor and the following procedure:

a. Set up the TM101 temperature monitoring unit.

b. Wipe off any vernix caseosa and stains from the sensor placement site with absorbent cotton or gauze dampened with acetone (CH_3COCH_3) or other appropriate solvent.

c. Affix the skin sensor probe to the infant's abdominal median line (halfway between the navel and the xiphoid process).

Cover the skin sensor probe with a Fisher & Paykel Sun Spot (800IW101) or Sun Dot (800IW102) to ensure a true skin temperature reading.

d. Plug the skin sensor probe into the TM101 temperature monitor.

viii. Allow 4-5 minutes for skin temperature readings to stabilise. Monitor the infant's skin temperature constantly, adjusting the manual heat control accordingly. Allow 4-5 minutes for the temperature to adjust to the new setting.

Warnings

Use only a Fisher & Paykel 800IW007 Skin Sensor Probe with the IW702 Servo Controller.

To ensure a true skin temperature reading cover the Skin Sensor Probe with a Fisher & Paykel Sun Spot (800IW101) or Sun Dot (800IW102).

ALARM

The IW703 Infant Warmer Head has an audible and visual OVERHEAT ALARM. If the overheat alarm has been activated, the warmer should not be used. Disconnect the warmer from power supply and consult a qualified technician, or contact your nearest Fisher & Paykel dealer.

1.2 IW702 Servo Controller.

As fitted to the IW703 Infant Warmer. Power supplied from the IW703 Infant Warmer.

The IW702 Servo Controller provides the IW703 Infant Warmer Head with servo control (PID) of the 600W radiant heater power.

1.2.1 Product Specifications.

Catalogue number:	IW702
Supply voltage:	10V ± 1V ~
Supply current:	0.5 A
Supply frequency:	50 / 60 Hz

1.2.2 Operating Instructions.

OPERATION

1. Operation in Servo Mode.

i. Ensure skin sensor probe is not plugged into the IW702 Servo Controller.

ii. Switch on power on IW703 Infant Warmer Head by depressing the POWER button.

iii. Switch on lights if desired, by depressing the LIGHTS button on IW703 Infant Warmer Head.

iv. The warmer will automatically start operating in SERVO mode and the IW702 Servo Controller will automatically go through an initialisation procedure. During this procedure the digital display will read '111', '222', ... '999'.

An audio alarm will sound and a 'Prb' message will show on the digital display to indicate that the skin sensor probe is disconnected. The red disconnect light will flash on and off. The audio alarm will sound and can be silenced for 6 minutes by depressing the MUTE button.

v. Test the IW702 Servo Controller by depressing the TEST button. The digital display should then read 38.0 degrees Celsius (plus or minus 0.2 degrees Celsius after 5 seconds).

vi. Check that the SERVO mode indication lights on both the IW703 Infant Warmer Head and IW702 Servo Controller are illuminated.

vii. To preheat the radiant warmer, switch to MANUAL mode on the IW703 Infant Warmer Head. Preheat for ten minutes with the HEAT CONTROL knob set to 10.

viii. Place the infant in the crib. (Ensure the manually set heat level currently controlling the radiant warmer is appropriate.)

ix. Wipe off any vernix caseosa and stains from the sensor placement site with absorbent cotton or gauze dampened with acetone (CH_3COCH_3) or other appropriate solvent.

x. Affix the skin sensor probe to the infant's abdominal median line (halfway between the navel and the xiphoid process). Cover the skin sensor probe with a Fisher & Paykel Sun Spot (800IW101) or Sun Dot (800IW102) to ensure a true skin temperature reading.

xi. Plug the skin sensor probe into the IW702 Servo Controller SKIN SENSOR SOCKET.

xii. Select SERVO mode on IW703 Infant Warmer Head by depressing the HEAT MODE button.

xiii. The desired skin temperature can be set using the IW702 Servo Controller's temperature control (between 32 and 37 degrees Celsius). The set temperature can be displayed by holding the MUTE button down for 3 seconds, and the flashing digital display indicates the desired set temperature. On releasing the MUTE button, the display reverts back to indicating the infant's actual skin temperature within 2 seconds.

xiv. Allow 4-5 minutes for the skin temperature readings to stabilise.

2. Operation in Manual Mode.

i. With the skin sensor probe plugged in and MANUAL mode selected, the IW702 Servo Controller can be used as a temperature monitor to display infant skin temperature.

ii. The heat output can be controlled manually with the HEAT CONTROL knob.

iii. With the skin sensor probe not plugged in and the MANUAL mode selected, the Servo Controller will go into Unmonitored MANUAL mode. The green MANUAL mode indicator on the IW702 Servo Controller will flash, the temperature display will be blank and all alarms, except the IW703 Infant Warmer Head overheat alarm, will be inhibited.

3. Routine Calibration Check of Skin Sensor Probe.

It is recommended that the Skin Sensor Probe is checked every three months to ensure that it is operating within its design specifications.

i. Obtain a good quality mercury thermometer.

ii. Place a thermometer and the probe cup end of the Skin Sensor Probe into a container of warm water which is between 30 degrees Celsius and 38 degrees Celsius.

iii. Switch on an IW703 Infant Warmer Head which has an IW702 Servo Controller attached. Plug the Skin Sensor Probe into the IW702 Servo Controller and set the temperature control to 37 degrees Celsius.

iv. Allow the temperature of the Skin Sensor Probe and thermometer to stabilise. Once stable, compare the temperature on the LED display of the IW702 to the reading of the thermometer.

v. The LED display should be within ± 0.5 degrees Celsius of the thermometer reading. If not, then it is recommended that the Skin Sensor Probe be replaced.

vi. Please also refer to the IW702/IW703 Technical Manual, Section 4.3 for further information with regard to Skin Sensor Probe calibration checks.

Warnings

Use only a Fisher & Paykel 800IW007 Skin Sensor Probe with the IW702 Servo Controller.

To ensure a true skin temperature reading cover the Skin Sensor Probe with a Fisher & Paykel Sun Spot (800IW101) or Sun Dot (800IW102).

ALARMS

The IW702 Servo Controller has audible and visual alarms for the following conditions:

1. High Temperature (high temperature light and audible alarm) - temperature is 1 degree Celsius greater than that set.
2. Low Temperature (low temperature light and audible alarm) - temperature is 1 degree Celsius less than that set.

   Note: The low temperature alarm is disabled during warm-up. It is enabled when the skin temperature reading is within 0.8 degrees of the set point or 30 minutes from switch on. (15 minutes with PC1 selected)
3. Skin Sensor Probe Failure of Disconnect ('Prb' display and audible alarm) - the skin sensor probe has been disconnected from the Servo Controller or has malfunctioned.
4. Incorrect Skin Sensor Probe Reading ('E20' display and audible alarm) - the temperature readings from the two skin sensor probe beads do not match - the skin sensor probe should be discarded.

5.* In Unmonitored MANUAL mode with PC1 selected (No alarms with PC1 open circuit) at 12 minutes an audible intermittent beep alarm. At 15 minutes a continuous audio alarm and flashing green MANUAL mode indicator during non-monitored operation.

* This option refers to the version 2.5 software only

1.3 Temperature Control.

PID control of 600 Watt radiant heater using IW702 Servo Controller.

1.3.1 Temperature Sensing.

Skin sensor temperature measurement using standard characteristic thermistors (YSI 400 compatible).

Option 1.	Single thermistor sensor.
Option 2.	Twin thermistor sensor.

With Option 2 the integrity of the two thermistors are continuously compared and their capability for servo control determined. Deviation from normal results in warmer shut down with an error message 'E20' in the display. Option 2 above is selected by a board level PCB programming input port (PC4). It requires the use of a twin thermistor skin temperature sensor (two identical thermistor sensors mounted in the probe head). To identify the twin thermistor sensor the cable is terminated with a blue coloured connector.

1.3.2 Temperature Display.

Three digit 14 mm 7 segment LED display.

Range 5 to 61°C. Below 5°C displays 'Lo'. Above 61°C displays 'Hi'.

Accuracy 30 to 40°C ± 0.3 °C. Resolution ± 0.1°C

1.3.3 Set Point Temperature.

Temperature selection by pointer knob on linear scale marked in one degree increments from 32 to 37. Maximum temperature is limited to 37 °C should the control be turned fully clockwise.

The set point can be displayed by holding the MUTE button down for 3 seconds then the flashing digital display indicates the set temperature. On releasing the MUTE button the display reverts within 2 seconds to indicating sensor temperature.

1.4 Alarms.

1.4.1 Temperature Alarms.

Tracking temperature alarm of plus or minus one degree from set temperature.

Indication by flashing Low and High temperature red LED's and audio alarm.

The Low temperature alarm is disabled during warm up. It is enabled when the sensor temperature is within 0.8 °C of the set point or 30 minutes from switch on (15 minutes with PC1 selected).

1.4.2 Sensor Disconnect Alarms.

If the skin temperature sensor probe is disconnected or develops a low or high resistance the disconnect alarm will be enabled. Indication is by a 'Prb' message on the digital display plus a flashing disconnect red LED and audio alarm.

1.4.3 Audio Alarm.

A choice of the ISO draft standard audio alarm or a gliding tone can be selected by a board level PCB programming input port (PC0).

A momentary depression of the MUTE button will silence the audio alarm for 6 minutes. The relevant LED indicators remain flashing until the alarm condition clears. Any new alarm condition occurring within a mute delay will cause the audio alarm to be re-enabled.

1.5 Safety Protection.

1.5.1 Temperature Deviations.

All alarm conditions cause an immediate power shut down of the overhead heater. In the case of a Low Temperature Alarm, muting the alarm causes heating to recommence, the Low Temperature LED however remains on until the fault has cleared.

Clearing a 'Prb' alarm will cause the low temperature alarm disable function to be enabled until such time as the temperature rises to within 0.8 °C of the set point.

There are three independent back-up over temperature protection circuits. Two are in the IW703 Infant Warmer Head and one in the IW702 Servo Controller.

The overheat protection in the warmer head is firstly a mechanical bimetallic thermostat mounted adjacent to the heater to sense any abnormal temperature rise.

The other back-up is a circuit which monitors the heater control duty cycle. Should the heater go to a 100% duty cycle in any 30 second period of operation an immediate power shut down phase will be initiated. Both the above safety back-up circuits cause a relay to latch out removing all power from the heater. Indication is by an overheat red LED and a continuous audio tone which can only be silenced by turning the mains power to the warmer head off.

In the IW702 Servo Controller an over temperature protection circuit independent of the microprocessor control continuously monitors the warmer operation. This back-up protection is preset to limit maximum temperature under fault conditions to 38 °C. The integrity of this protection can be checked by the following method:

(a) Remove the skin temperature sensor (probe) from the connector socket.
(b) Observe 'Prb' display, flashing sensor disconnect LED and audio alarm.
(c) Push the TEST switch.
(d) Observe display indicates 38 ± 0.2 °C.
(e) On warmer head observe that yellow duty cycle LED is off.

1.5.2 Sensor Isolation.

The skin temperature sensor is removed from the ground leakage path by a totally isolated high frequency switching power supply and optoisolator interface (leakage current $< 10\ \mu A$).

1.5.3 Microprocessor Watch Dog.

A control loop in the operating software continuously monitors for correct operation. Should a fault be detected a hardware reset circuit attempts to reinitialise the microprocessor. If this is not successful additional hardware disables the heating circuit, blanks the display and turns the high temperature red LED on. The watch dog circuit is tested at turn on by deliberately halting the processor and forcing initialisation. Also tested at turn on and thereafter every 110 minutes, for correct operation is the isolation relay lockout circuitry. A failure here is indicated by an 'E30' error message in the display.

1.6 Basic Operating Modes.

(a) When IW703 Infant Warmer Head is fitted with IW702 Servo Controller.

The IW703 Infant Warmer Head initialises in the Servo mode. Indication is by a green LED indicator on the IW703 Infant Warmer Head control panel and also by a green LED on the IW702 Servo Controller front panel.

The manual operating mode has to be deliberately selected from the IW703 Infant Warmer Head control panel. Indication is again by green LED indicators on both the IW703 Infant Warmer Head and IW702 Servo Controller.

Switching between manual/servo modes cancels any low temperature alarms, resets the warm up time out and disables any low temperature alarms until the sensor is within 0.8 °C of the set point.

(b) When IW703 Infant Warmer Head is not fitted with IW702 Servo Controller.

The IW703 Infant Warmer initialises with the manual heat control disabled. The MANUAL mode green LED indicator on the IW703 Infant Warmer Head control panel will not be lit.

To enable the manual operating mode, depress the HEAT MODE button on the IW703 Infant Warmer Head control panel. Indication is by a green LED indicator on the Infant Warmer Head control panel (MANUAL mode).

The IW703 Infant Warmer Head HEAT CONTROL is then adjusted to give the desired heat setting.

1.6.1 Servo Operation (with IW702 Servo Controller fitted).

In the servo operating mode the temperature sensor must be attached to the infant and the desired operating temperature selected on the IW702 Servo Controllers temperature control. The heat control on the IW703 Infant Warmer Head has no influence in this mode of operation.

1.6.2 Manual Operation (with IW702 Servo Controller fitted).

In the manual mode the operator has the option of all monitoring facilities (except servo control) with the sensor plugged in, or the equivalent of switching the servo unit off (unmonitored MANUAL mode).

When the manual mode is selected if the patient sensor is not connected to the IW702 Servo Controller the only indication of manual control is the green manual LED indicator on the IW702 Servo Controller. The temperature display is blanked and all alarms, visual and audible are inhibited. On plugging in the sensor however, all functions revert to normal operation and the IW702 Servo Controller can then be used in a monitoring mode. If the sensor is subsequently unplugged, a 'Prb' alarm is initiated which on muting causes the unmonitored MANUAL state above to be re-entered.

1.7 Calibration.

The only temperature calibration required is on the IW702 Servo Controller and is the 38 degree analog over temperature control. This is accomplished in the following way:

(a) Connect a voltmeter (5 volt range) between the OVHT test point and ground on the servo PCB.
(b) Push the TEST button and adjust VR3 to the point where the voltage just changes from a high level to a low.

Alternatively adjustment can be performed without the use of an indicating meter.

(a) From the engineering menu enter engineering test A (Refer to Section 3.0.2 and 3.0.3).
(b) Push the TEST button and adjust VR3 on the back of the IW702 Servo Controller PCB, so the display just changes from vertical bars 'A||||' to horizontal 'A=='.

1.8 Environmental Specifications.

	Operation	Transport	Storage
Temperature	18 °C to 29 °C	- - - - -	-10 °C to 60 °C
Humidity	0 to 90%	- - - - -	0 to 90%
Vibration	normal nursery handling	normal transport handling	- - - - -

1.9 Standards and Approvals (Grey Models).

Classification under IEC 601-1:1988
AS 3200.1:1990

Class 1
Type B
Continuous operation
Not classified against the ingress of liquid
Not suitable for use in the presence of a flammable anaesthetic mixture with oxygen or nitrous oxide

2.0 Circuit Operation.

2.1 Introduction.

This section describes briefly the operation of the IW703 Infant Warmer Head as fitted to IW817, IW818 and IW820 Infant Warmers, and the IW702 Servo Controller which can optionally be fitted to all the above models. Refer to the Circuit Diagrams in Section 4.0.

2.2 IW703 Infant Warmer Head.

(Refer to Section 4.5 Circuit Diagram 043 040 571 IW703 Infant Warmer Head.)

On turning the power switch SW3 on, the overhead fluorescent lights and heater are initiated in the off state by the Power On Set circuitry of U2-A. Optocouplers U4 and U5 totally isolate the control circuitry from the mains power supply. Power to the 600 Watt overhead radiant heater assembly is switched by triac Q5 and time cycle controlled by the circuitry between transistors Q1 and Q2.

The HEAT CONTROL potentiometer VR1 controls the on time (duty cycle) from about 5% to a maximum of 99%. The reason for this less than 100% duty cycle is for fail safe monitoring purposes (Refer to Section 2.2.1). The on time is indicated by the yellow duty cycle LED D9. The HEAT MODE control, push button SW1 selects the heater power on or off, the state of which is indicated by the green, MANUAL mode LED D7.

If the optional servo unit (IW702) is fitted, the HEAT MODE push button then selects this option when not in MANUAL mode and indication is by the SERVO mode green LED D4. Similar to the above, the circuitry between push button SW2 and triac Q6 controls the fluorescent lights the state of which is indicated by D8 a green LIGHTS LED.

2.2.1 Manual Overheat Protection.

At power on, Q9 is driven into saturation by the Power On Set circuit of U2-A through C10 and D16. This quickly charges C2 ensuring that pin 14 U1-D is low. During normal circuit operation Q9 is driven into saturation by the state of optoisolator U6. The state of the opto is determined by the current sourced from the bridge rectifier D12 driven in turn from the snubber network R34 and C9.

As long as the heater control circuit does not go to a 100% duty cycle for longer than the time constant of R2, C2 (approximately 30 seconds) normal operation will ensue. If however a fault occurs which causes Q5 the heater switching triac to go to continuous conduction, Q9 will come out of saturation, allowing pin 12 U1-D to float high as C2 discharges through R2. Eventually pin 14 U1-D goes high saturating Q7 and shunting base drive from Q8. This in turn disables relay RL1 isolating the heating circuit from mains power. At the same time pin 6 U2-C is also driven high enabling the audio alarm circuit U1-C and turning on the OVERHEAT ALARM red LED D10.

The temperature in the IW703 Infant Warmer Head is monitored by the bimetallic over-heat protector H1, which is mounted adjacent to the heater elements. If the temperature rises excessively H1 opens initiating the same shut down procedure as described above.

The overheat audio alarm can only be disabled by turning the mains power off. The audio alarm will remain active as long as the temperature is excessive or until such time as the overheat protector can be manually reset.

2.3 IW702 Servo Controller.

2.3.1 Isolation Circuit and A to D Conversion.

(Refer to Section 4.6 Circuit Diagram 043 040 567 IW702 Servo Controller - Sheet 1.)

The skin sensor probe is isolated from ground on this section of the PCB by the high frequency switching power supply transformer T1. Control and clock signals from the microprocessor are passed to this isolated circuit through optoisolators U8 and U9 and loaded into the shift register U11 by the clock and load network of U10-A and U10-B. The current control signal latched into the shift register is then communicated to the multiplexers U12 and U13. The 1 by 8 analog multiplexer U13 selects in turn, voltage levels from the temperature control VR2, the skin temperature sensor probe and the calibration resistors R17, R18 and R19.

These sample voltage levels are applied to pin 5 of U14-B where they are amplified and passed to the comparator U14-C. The 3 by 2 multiplexer U12 controls the switching of the integrator U14-A. The start of an integration period is conveyed by a transient through C27 and the end by pin 8 of the comparator U14-C going high. The start and stop signals of the integration ramp are passed by the high speed optocoupler U16 to the microprocessor where by interrupt control they start and stop a counter timer. Thus the input voltage levels are referenced to a discrete count completing the analog to digital conversion.

2.3.2 Servo Over Temperature Protection and 38 °C Test.

The comparator U14-D has its input connected directly to the skin temperature sensor and is referenced via VR3 to a voltage level equivalent to 38 °C. If the skin temperature sensor exceeds 38 °C pin 14 U14-D goes low enabling optoisolator U17. This output signal from the opto is used to disable heating and is totally independent of microprocessor control.

The resistor network of R32, 33, 81, 82, 83 (adjusted during manufacture to an equivalent temperature of 38 °C) is switched into circuit by the TEST button SW1 and reed relay RL1 to give a visual check of the digital display accuracy. This 38 °C reference is also used in the setting of VR3 which is the only calibration required on the IW702 unit.

2.3.3 Microprocessor Control.

(Refer to Section 4.7 Circuit Diagram 043 040 567 IW702 Servo Controller - Sheet 2.)

The output from the high speed optocoupler U16 is squared by U2-C and fed to the RST 6.5 input of the microprocessor U3. Here under software control, the counter in the I/O control IC U6, is directed to reflect the magnitude of the input analog voltages from the multiplexer U13. The SOD line of U3 supplies both the serial data for the isolation circuit commands and the digital display information.

This data is shifted by the ICLK (Isolation Clock) and DCLK (Display Clock) respectively. A sample of the mains power is taken via C19, shaped by U2-D and applied to the RST 5.5 input of U3. Software control determines the frequency and derives a real time clock for internal timing. Also synthesised by a software control loop is a Watch Dog Clock (WDT) which is synchronised to the mains frequency. This WDT clock drives the full wave bridge rectifier circuit U1-C, U1-A through U2-A to the trap input of U3. If the internal software loop collapses, or its cyclic nature is interrupted, the WDT will fail and within 50 - 100 milliseconds the output pin 3 of U2-A will drive the trap input high. This will force the processor to endeavour to resume program control. If this is not successful the continuing high trap signal, will via U1-B isolate the triac heater control circuit and via Q3 blank the digital display. In the event of an excessive skin temperature probe reading, the OVHT (38 °C Overheat) line which originates from opto U17 of the isolation circuit also disables the triac heater control circuit via U2-B.

Control lines DCINH (Duty Cycle Inhibit) and DTYRST (Duty Cycle Reset) in combination with Q17 under software control periodically test the isolation relay in the IW703 Infant Warmer Head.

Control lines MNLSRV and OVRTMP sense manual or servo operation as selected from the warmer head and with Q16 provide for heater shut down if the servo unit, while operating in manual mode detects alarm temperature conditions.

3.0 Performance Check and Calibration.

The IW702 Servo Controller has a number of functional display and self test monitoring routines which are accessed in the following way. The use of these routines facilitates the performance check and calibration procedure.

3.0.1 Display of Temperature Control Setting.

If the MUTE button on the IW702 Servo Controller is held down for 3 seconds the skin sensor temperature display will convert to displaying the precise setting of the temperature control knob. To indicate this display condition the display alternately flashes on for approximately a one second interval and off for half a second. When the MUTE button is released the display blanks and within one second reverts to continuous display of the Skin Sensor Probe measurement.

3.0.2 Engineering Menu.

The engineering menu is entered in the following way:

(a) Press the MUTE button until the display of the temperature control flashes, and hold for approx. two seconds.

(b) Release the MUTE button at the instant of the display flashing on, then press and hold after the display has flashed off (approx. half a second later).

(c) As the display flashes on, again release the MUTE button, then press and hold as the display flashes off.

(d) The engineering menu is now entered, and if the MUTE button is now held down the centre digit of the display will step at two second intervals through the numbers one to six (-1- to -6-).

(e) To enter the various engineering functions (indicated by the rotating numbers 1 to 6), as the desired function is indicated release the MUTE button momentarily, and when the display changes the MUTE button is again pressed and held, to enter the displayed function.

The functions displayed are listed below.

1	Servo controller model number.
2	Software version number.
3	Heater duty cycle.
4	Programming link status (Port 5 to 0).
5	Software release number.
6	Optional exit, not a visible display function.

When the MUTE button is released the next function number will be displayed (1 second) but if the button is not pushed again the display will revert (2 seconds) to the display of the skin temperature sensor.

3.0.3 Engineering Tests Menu.

The engineering test menu is entered from the engineering menu in the following way. Enter engineering menu number 5. Hold the MUTE button down and remove the temperature probe. Release the MUTE button. The various engineering tests are indicated by the left hand digit of the display showing the letters A through F. Each test is held as long as the MUTE button is up. To step to the next test just push the MUTE for about 1 second. The engineering tests are described below.

A	Calibration of 38 degree over temperature control.
b	Heater duty cycle inhibit test. Relay drop out time indicated in seconds.
c	Integral display.
d	N/A
E	N/A
F	Exit engineering tests to normal servo control of skin temperature.

If the MUTE button is not touched for 6 minutes the engineering test mode will terminate. As the normal software control loop is interrupted during the engineering test mode it is not advisable to enter this mode during clinical operating conditions.

3.1 Performance Checks.

3.1.1 IW703 Infant Warmer Head Performance Check.

The following test can be carried out on an IW817, IW818 or IW820 Infant Warmer, fitted with an IW703 Infant Warmer Head, to ensure that all functions are to design specifications.

Do not perform this test if the IW817, IW818 or IW820 Infant Warmer is fitted with the optional IW702 Servo Controller as the test is then better performed under software control (Refer to Section 3.1.2) and also no dismantling of the IW703 Infant Warmer Head is required.

1. Equipment Required.

Phillips screwdriver and a short length of hook up wire.

2. Manual Head Performance Check Sequence.

with IW702 disconnected
ie J6 disconnected & pin 5+6 short-

(a) Locate the 8 way servo harness connector at the rear of the IW703 Infant Warmer Head and with a short length of wire short pins 1 and 3 of this 8 way socket together. Or alternately on the IW703 Infant Warmer Head PCB join the junction of R15 and R44 to the anode end of D15. This will turn the heater control triac to 100% duty cycle when the MANUAL mode is selected on.
(b) Connect Warmer to power outlet and turn on.
(c) Check Warmer initialises with heater and fluorescent lights off.
(d) Select MANUAL mode. Note time.
(e) Check MANUAL mode green LED on. Duty cycle yellow LED on.
(f) Check after 60 seconds ± 30 seconds delay, red overheat LED and audio alarm come on.
(g) Check yellow duty cycle LED off.
(h) Turn off mains power and remove shorting link from 8 way socket or PCB.
(i) Turn on power. Check head initialises with heater and fluorescent lights off.
(j) Push LIGHTS switch. Check green LED on and fluorescent lights come on.
(k) Push HEAT MODE switch. Check green LED on. Amber light flashing (15 second period).
(l) Rotate HEAT CONTROL (VR1) fully anticlockwise. Check for low duty cycle ie. very brief (up to 2 seconds) or no flash of amber LED.
(m) Rotate HEAT CONTROL slightly clockwise. Check duty cycle increases proportionally.
(n) Rotate HEAT CONTROL fully clockwise. Check for 99% duty cycle ie. the amber light must briefly flash off then on again.
(o) Rotate HEAT CONTROL slightly anticlockwise. Check duty cycle decreases proportionally.

3. Manual Head Run Check.

In a maximum temperature of 27 °C ± 2 °C, the radiant warmer can be run at 100% duty cycle (ie continuously) as long as the following conditions are met:

a. At least 0.9 metres (36") clear airspace AROUND the radiant warmer.
b. At least 0.6 metres (24") clear airspace ABOVE the radiant warmer.

3.1.2 IW702 Servo Controller Performance Check.

The following test can be carried out on an IW817, IW818 or IW820 Infant Warmer, with an IW703 Infant Warmer Head, to which the optional IW702 Servo Controller is fitted, to ensure that all functions are to design specifications.

All the tests (Section 3.1.2 (3)) must be sequenced in exact order as a successful test pass is dependent in most cases on previous control settings and test results.

1. Equipment Required.

34.5 °C Test Probe.

The 34.5 °C Test Probe is a bantam phone plug with two 1500 Ohm 1% resistors wired in circuit. This is equivalent to a temperature of 34.5 °C.

2. Servo Controller Test Set-up.

(a) Ensure IW703 Infant Warmer Head HEAT CONTROL turned fully clockwise.
(b) Plug 34.5 °C Test Probe into IW702 Servo Controller.
(c) Turn IW702 Servo Controller temperature control fully clockwise (37).

3. Servo Controller Performance Check Sequence.

(a) Turn on the IW703 Infant Warmer Head.
(b) Observe count up on IW702 Servo Controller. Check all LED's flash alarm beeps. Check display reads approximately 34.5.
(c) On IW703 Infant Warmer Head - Check SERVO green LED on.
(d) On IW702 Servo Controller - Check SERVO mode green LED on.
(e) Check there is no audio alarm or alarm LED's.
(f) Turn IW702 Servo Controller temperature control fully anticlockwise (32).
(g) Check IW702 Servo Controller high temperature alarm LED and audio on. On IW703 Infant Warmer Head - Check yellow duty cycle LED off.
(h) Turn IW702 Servo Controller temperature control fully clockwise (37).
(i) Check low temperature alarm LED and audio on.
(j) Check operation of MUTE button (Alarm Mute).
(k) Display temperature control setting (Refer to Section 3.0.1). Check temperature control knob alignment with front panel calibration (34, 36 degrees).
(l) Enter engineering menu (Refer to Section 3.0.2). Check software version at number 2.
(m) Enter engineering test menu number A (Refer to Section 3.0.3).
(n) Push TEST button and check display shows horizontal bars (if not Refer to Section 3.2).
(o) Ensure IW702 Servo Controller temperature control fully clockwise. Plug in 34.5 °C Test Probe and enter engineering test b.
(p) Wait for audio alarm at safety relay time out (30 to 90 seconds indicated on display).
(q) Momentarily push the MUTE button and check for safety relay reset and audio alarm cessation (Q17 test).
(r) Return to normal operation (engineering test F). Remove 34.5 °C Test Probe.
(s) Push TEST button and check display reads 38.0 ± 0.2 degree (mute alarms if desired).
(t) Ensure IW702 Servo Controller temperature control fully clockwise (37) and plug in the 34.5 °C Test Probe.
(u) On IW703 Infant Warmer Head select MANUAL CONTROL.
(v) Check MANUAL mode LED on IW702 Servo Controller is on.
(w) Turn IW702 Servo Controller temperature control fully anticlockwise (32) - check high alarm.
(x) On IW703 Infant Warmer Head - Check MANUAL mode LED off, duty cycle LED off (Q16 test).
(y) Remove 34.5 °C Test Probe - Push the MUTE - Check display blanks - no alarms. On the IW703 Infant Warmer Head - Check MANUAL mode LED on, duty cycle LED on.
(z) Now go to Section 3.1.1 (2) and perform tests (l) to (o) on the IW703 Infant Warmer Head.

3.2 IW702 Servo Controller Calibration.

There is only one temperature calibration adjustment to perform. (38 °C Over Temperature Protection. Refer to Sections 1.7 and 2.3.2.) This is a critical adjustment related to patient safety and must be carried out and set exactly. The correct setting point is where the display just changes from a vertical to a horizontal bar display.

On accomplishing this transition, back the control (VR3) off slightly to return to the vertical bar display and again adjust for the horizontal display to ensure that the adjustment in on the point of transition.

3.2.1 38 °C Over Temperature Protection Calibration.

(a) Enter engineering test A (Refer to Sections 3.0.1 - 3.0.3).
(b) Push the Servo TEST button and adjust VR3 so the display just changes from vertical bars 'A||||' to horizontal 'A=='.
(c) Back off VR3 slightly to return to the vertical display 'A||||' and repeat step b.
(d) Exit through engineering test F and check that the displayed message 'Prb' changes through '---' to indicate 38.0 ± 0.2°C approximately 1 second after pushing TEST button.

4.0 Servicing Information.

During operation if the microprocessor U3 does not receive an expected interrupt within a given time window an error condition will be flagged. In particular the RST 6.5 interrupt which marks the start and stop of the integration ramp from U14-A and also controls the counter in U6 will in the event of the count exceeding certain limits generate an error message. When the count recorded by U6 is less than 256 an underflow error is generated and should the count exceed 16128 an overflow error is indicated.

While operating normally a square wave of the same period as the mains power supply should be present on pins 8 and 9 of U1-C. This the Watch Dog Toggling signal, sourced from U6, should maintain pin 3 of U2-A low.

Some of the error indications which can be displayed on the IW702 Servo Controller are listed below, with an explanation of the possible cause, and corrective actions.

Error Code	Explanation	Action
...	Failure to establish automatic Watch Dog Toggling.	Check for Watch Dog Clock and Watch Dog Toggling signal.
Ec	Checksum error.	Check possible failure of U5 EPROM.
En	Memory test error.	Check possible failure of U6 RAM.
b-1 *	Mute button stuck down.	Free or replace SW2.
b-2 *	Test button stuck down. (only if skin sensor not plugged in)	Free or replace SW1.
EXx	Where X = 0 through 7, indicating multiplexer stage where error occurred. Where x = o or u, indicating ADC overflow error or underflow error.	See Explanation.
Prb	Temperature sensor not plugged in. Or, thermistor resistance not between 200 ~ 8000 Ohms.	Plug in Temperature Sensor. Check thermistor resistance for each bead between 200 ~ 8000 Ohms.
E20	Twin probe mismatch. Thermistors not within 2% tolerance.	Clean jack plug, check for faulty contacts in jack socket, check thermistor resistances. If thermistor resistance not within 2% tolerance or if E20 still exists, discard probe.
E30	Failure of isolation relay drop out self test.	Check for isolation relay dropout prior to reset after approx 55 seconds from initial power on. Check 38 °C Overtemp Calibration. (Refer Section 3.2.1.)
E31	Failure of isolation relay to reset after self test. Or, open circuit in heater circuit.	Check for isolation relay RL1 reset after approx. 55 seconds from initial power on. Check 38 °C Overtemp Calibration. (Refer Section 3.2.1.) Check elements for open circuit. If so, replace.
E32	Incorrect Analog 38 °C Overtemp Calibration.	Check calibration of 38 °C Overtemp. (Refer Section 3.2.1.)

* These error codes refer to the version 2.5 software only.

Other Error Conditions:

If the display remains blank and only the high temperature red LED is on, then the microprocessor has crashed or failed to initialise. Check for Watch Dog Toggling signal. Check status of EPROM.

If during the start routine, the display fails to count past '000', check isolation power supply or optoisolators U8, U9 and U16.

If on pushing the TEST button a 'Prb' error continues to display, check calibration of VR3 on rear of IW702 Servo Controller PCB (Refer to Section 3.2).

4.1 Option Selection.

A number of operational functions can be optionally selected by linking the pads of Port PC0 - 5 on the back of the Servo Controller PCB.

Options	Pads Open	Pads Joined
PC0	ISO Draft Standard Alarm.	Continuous gliding audio alarm tone.
PC1	30 min. warm up in servo/man-monitor mode. No Unmonitored Manual alarm.*	15 min warm up.(servo/man monitor only) 15 min unconditional Unmonitored Manual alarm.*
PC2		
PC3		
PC4	Single Thermistor Temperature Sensor.	Twin Probe (Two thermistors sensor).
PC5	N/A	

* These options refer to version 2.5 software only.

4.2 Overheat Alarm.

The OVERHEAT ALARM on the IW703 Infant Warmer Head is enabled either by the detection of a 100% duty cycle or the operation of the mechanical overheat protector H1. The audio alarm can only be silenced by turning the IW703 Infant Warmer Head power switch off.

To determine which fault caused the alarm, if the power is again turned on and the overheat alarm commences immediately it is the overheat protector which has open circuited. If the fault is the uncontrolled duty cycle of the warmer head then the alarm will not be enabled before a delay of about 45 to 75 seconds after switch on.

The overheat protector reset mechanism is accessible through the small hole about 50 mm to the rear of the IW703 Infant Warmer Head radiant heater. It can be reset by inserting a thin shaft, a 2 mm Allen key is ideal and using a moderate upward pressure. Allow at least 5 minutes for the head to cool before attempting to reset.

Before resetting, the IW703 Infant Warmer Head should be examined for some cause of the overheat, such as restricted ventilation of the IW703 Infant Warmer Head or noticeable damage to the radiant heaters.

4.3 Skin Temperature Sensor Test (Probe).

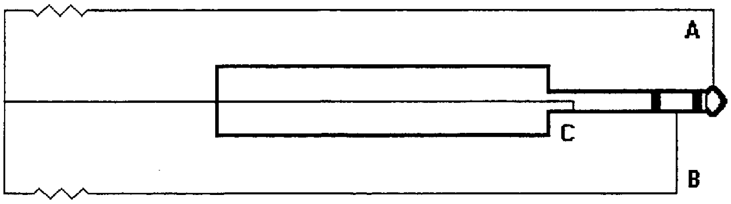
If using a twin thermistor temperature sensor identifiable by a blue connector plug, the following test should be carried out every three months to check for internal shorts in the sensor head or cable. Although the processor program checks for equal circuit paths it does not determine if the individual conductors in the sensor cable are shorted to one another or if there are symmetrical partial shorts of the thermistor beads.

If the skin sensor has been at ambient temperature for at least 10 minutes and the sensor end has not been handled, use an accurate thermometer to determine the ambient temperature. Alternately the sensor together with the thermometer may be placed in a container of warm water at a temperature between ambient and 40 °C. From the thermometer reading determine the correct skin sensor resistance using the chart over. Now using a digital Ohm meter (0 - 10000 Ohms range) note the following resistances.

Measure Path A - C = x
Measure Path B - C = y
Measure Path A - B = z

Then $x = y = z/2 = R$ (tolerance < 2%)

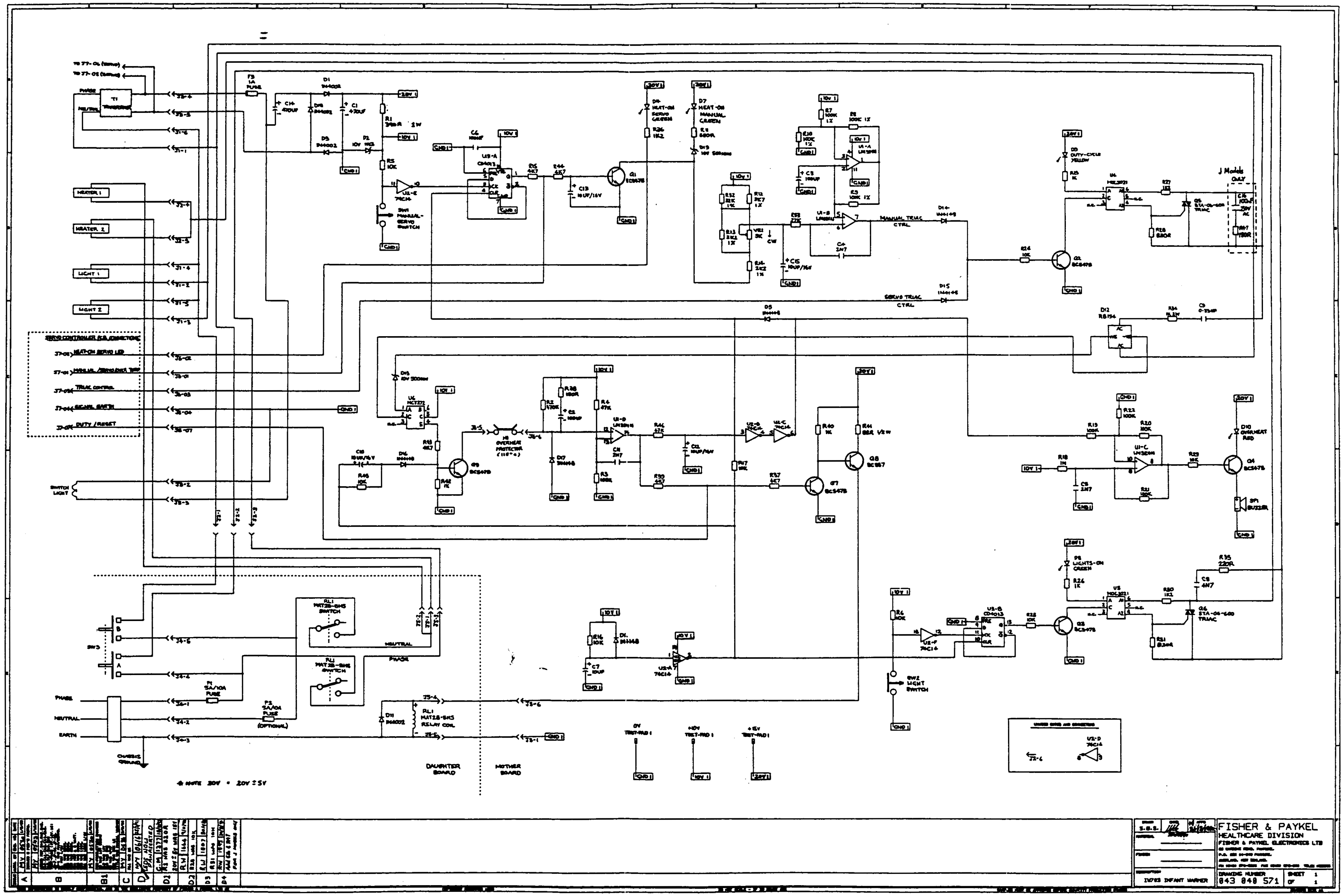
Where R = resistance at the thermometer temperature (refer to Section 4.4).



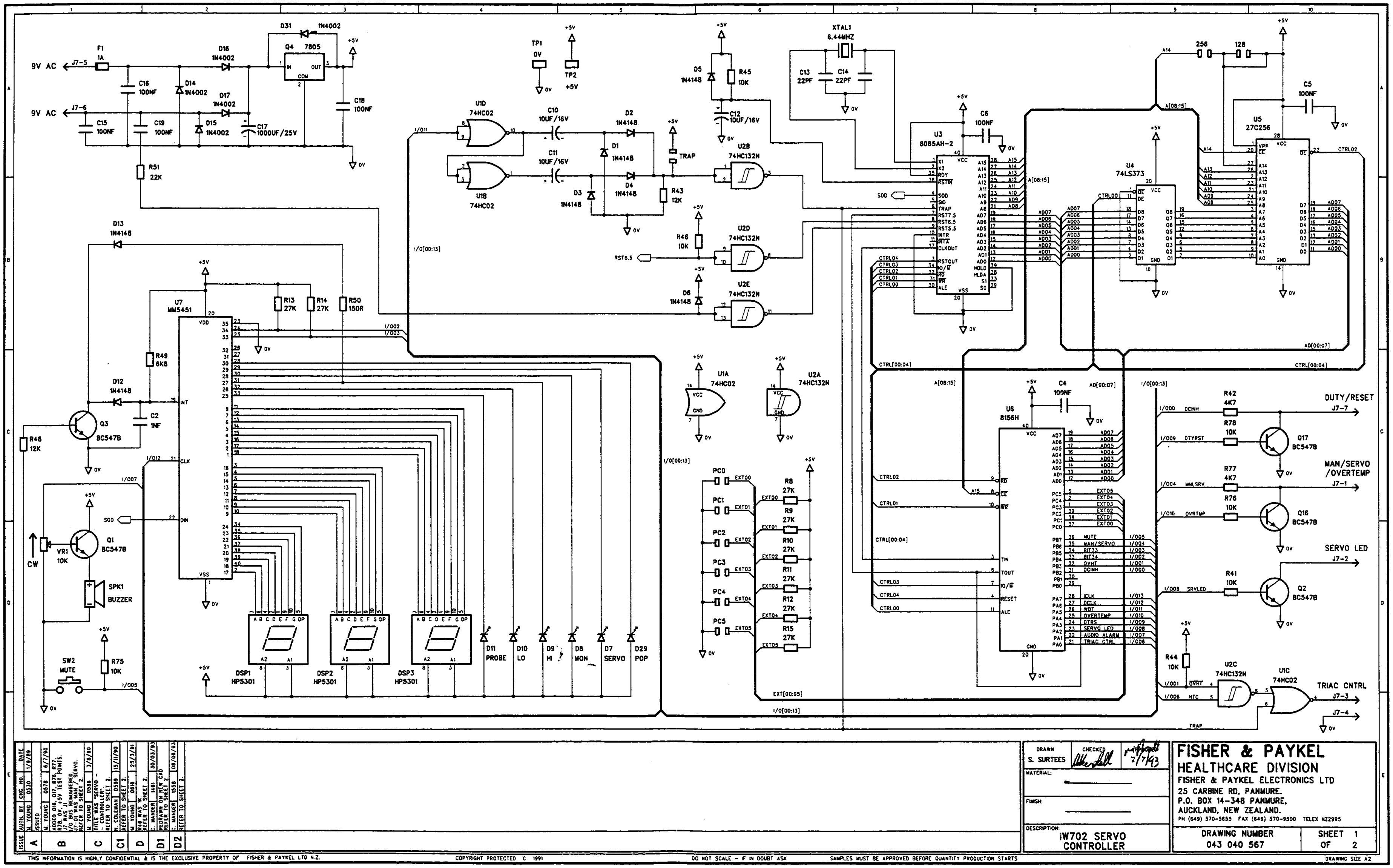
4.4 Probe Temperature versus Thermistor Resistance.

Temperature (°C)	Resistance (Ohms)	Temperature (°C)	Resistance (Ohms)
20	2812.8	30	1814.4
21	2688.9	31	1739.2
22	2571.8	32	1667.2
23	2459.2	33	1598.2
24	2353.3	34	1532.9
25	2250.0	35	1470.6
26	2155.8	36	1411.3
27	2064.4	37	1355.0
28	1976.6	38	1301.0
29	1893.3	39	1249.2

4.5 IW703 Infant Warmer Head Circuit Diagram 043 040 571.


HEATER 1
HEATER 2
LIGHT 1
LIGHT 2
SERVO CONTROLLER P.C.B. CONNECTIONS
HEAT-ON SERVO LED
MANUAL/SERVO DUTY TRIP
TRIAC CONTROL
SIGNAL EARTH
DUTY / RESET
SWITCH LIGHT
SW3
PHASE
NEUTRAL
EARTH
CHASSIS GROUND
RL1 MAT28-6H5 SWITCH
RL1 MAT28-6H5 RELAY COIL
D11 1N4002
F1 5A/10A FUSE
F2 5A/10A FUSE (OPTIONAL)
DAUGHTER BOARD
MOTHER BOARD
T1 TRANSFORMER
F3 1A FUSE
C14 470UF
C1 470UF
D1 1N4002
D3 1N4002
R1 390R 1W
Z2 10V 1W3
R5 10K
U2-E 74C14
SW1 MANUAL-SERVO SWITCH
C6 100NF
U3-A CD4013
R15 4K7
R44 4K7
C13 10UF/16V
Q1 BC547B
D6 HEAT-ON SERVO GREEN
R36 1K2
D7 HEAT-ON MANUAL GREEN
R8 680R
D13 10V 500mW
R7 100K 1%
R9 100K 1%
R10 100K 1%
C3 100NF
U1-A LM324N
R3 100K 1%
R32 22K 1%
R12 2K7 1%
R13 2K2 1%
VR1 5K
R14 2K2 1%
C15 10UF/16V
R52 27K
U1-B LM324N
C4 2N7
MANUAL TRIAC CTRL
D14 1N4148
SERVO TRIAC CTRL
D15 1N4148
R24 10K
Q2 BC547B
D9 DUTY-CYCLE YELLOW
R25 1K
U4 MOC3021
R27 1K2
Q5 STA-06-600 TRIAC
R28 680R
J Models ONLY
C16 100nF 250V AC
R47 150R
D12 RB154
R34 8.2W
C9 0.33UF
D5 1N4148
D15 10V 500mW
U6 MCT271
C18 10UF/16V
D16 1N4148
R46 10K
R43 4K7
R42 1K
Q3 BC547B
H1 OVERHEAT PROTECTOR (110°C)
R2 470R
R38 100R
C2 100NF
D17 1N4148
R4 47K
U1-D LM324N
R3 100K
C11 2N7
R42 47K
C12 10UF/16V
U2-B 74C14
U2-C 74C14
R47 10K
R39 4K7
R37 4K7
Q7 BC547B
R40 1K
R41 82R 1/2W
Q8 BC557
R22 100K
R19 100K
R20 10K
U1-C LM324N
R18 1M
C5 2N7
R21 100K
R23 10K
Q4 BC547B
D10 OVERHEAT RED
SP1 BUZZER
D8 LIGHTS-ON GREEN
R26 1K
U5 MOC3021
R30 1K2
R35 220R
C8 4N7
Q6 STA-06-600 TRIAC
R31 8.2K
R6 10K
U2-F 74C14
U3-B CD4013
R29 10K
Q3 BC547B
SW2 LIGHT SWITCH
R16 10K
D1 1N4148
C7 10UF
U2-A 74C14
0V TEST-PAD 1
+10V TEST-PAD 1
+15V TEST-PAD 1
UNUSED GATES AND CONNECTIONS
U2-D 74C14
NOTE 20V = 20V ± 5V
FISHER & PAYKEL
HEALTHCARE DIVISION
FISHER & PAYKEL ELECTRONICS LTD
IW703 INFANT WARMER
DRAWING NUMBER
043 040 571
SHEET 1
OF 1

4.6 IW702 Servo Controller Circuit Diagram 043 040 567 Sheet 1.


9V AC
J7-5
J7-6
F1
1A
D31
1N4002
D16
1N4002
D14
1N4002
D17
1N4002
D15
1N4002
Q4
7805
IN
OUT
COM
C16
100NF
C15
100NF
C19
100NF
C17
1000UF/25V
C18
100NF
R51
22K
D13
1N4148
TP1
0V
TP2
+5V
U1D
74HC02
U1B
74HC02
C10
10UF/16V
C11
10UF/16V
D1
1N4148
D2
1N4148
D3
1N4148
D4
1N4148
D5
1N4148
R45
10K
C12
10UF/16V
TRAP
R43
12K
U2B
74HC132N
U2D
74HC132N
U2E
74HC132N
R46
10K
RST6.5
D6
1N4148
XTAL1
6.44MHZ
C13
22PF
C14
22PF
U3
8085AH-2
C6
100NF
U4
74LS373
U5
27C256
C5
100NF
256
128
A[08:15]
AD[00:07]
CTRL[00:04]
I/O[00:13]
U7
MM5451
R13
27K
R14
27K
R50
150R
R49
6K8
D12
1N4148
C2
1NF
Q3
BC547B
R48
12K
SOD
Q1
BC547B
VR1
10K
CW
SPK1
BUZZER
SW2
MUTE
R75
10K
DSP1
HP5301
DSP2
HP5301
DSP3
HP5301
D11
PROBE
D10
LO
D9
HI
D8
MON
D7
SERVO
D29
POP
U1A
74HC02
U2A
74HC132N
PC0
PC1
PC2
PC3
PC4
PC5
R8
27K
R9
27K
R10
27K
R11
27K
R12
27K
R15
27K
EXT[00:05]
U6
8156H
C4
100NF
MUTE
MAN/SERVO
BIT33
BIT34
OVHT
DCINH
ICLK
DCLK
WDT
OVERTEMP
DTRS
SERVO LED
AUDIO ALARM
TRIAC CTRL
R42
4K7
DUTY/RESET
J7-7
R78
10K
Q17
BC547B
R77
4K7
MAN/SERVO
/OVERTEMP
J7-1
R76
10K
Q16
BC547B
SERVO LED
J7-2
R41
10K
Q2
BC547B
R44
10K
U2C
74HC132N
U1C
74HC02
TRIAC CNTRL
J7-3
J7-4
+5V
0V

ISSUE	AUTH. BY	CHG. NO.	DATE
A	M. YOUNG ISSUED	0530	1/9/89
B	M. YOUNG ADDED Q16, Q17, R76, R77, R78, 0V, +5V TEST POINTS. J7 WAS J1 I/O BUS RENUMBERED. J7-01 WAS MAN / SERVO. REFER TO SHEET 2.	0578	6/7/90
C	M. YOUNG TITLE WAS "SERVO - CONTROLLER". REFER TO SHEET 2.	0588	3/8/90
C1	N. COLEMAN REFER TO SHEET 2.	0599	15/11/90
D	M. YOUNG R46 WAS 1K. REFER TO SHEET 2.	0618	25/3/91
D1	C. MANDER REDRAWN ON NEW CAD REFER TO SHEET 2.	1461	30/03/93
D2	C. MANDER REFER TO SHEET 2.	1558	08/06/93

DRAWN	CHECKED	APPROVED
S. SURTEES	Allerdall	7/7/93

MATERIAL:

FINISH:

DESCRIPTION:
IW702 SERVO
CONTROLLER

FISHER & PAYKEL
HEALTHCARE DIVISION
FISHER & PAYKEL ELECTRONICS LTD
25 CARBINE RD, PANMURE.
P.O. BOX 14-348 PANMURE,
AUCKLAND, NEW ZEALAND.
PH (649) 570-5655 FAX (649) 570-9500 TELEX NZ2995

DRAWING NUMBER
043 040 567

SHEET 1
OF 2

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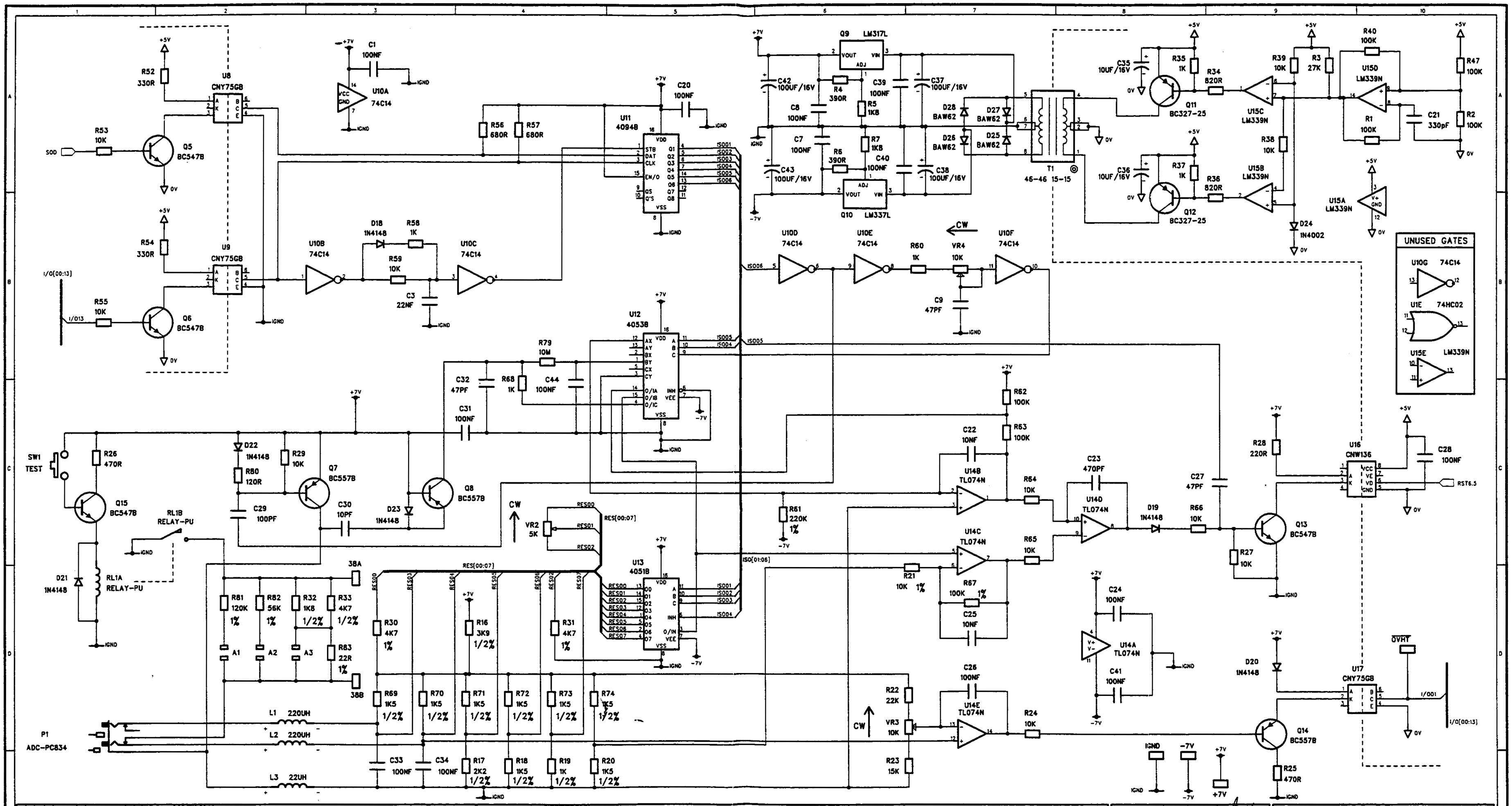
DO NOT SCALE - IF IN DOUBT ASK

SAMPLES MUST BE APPROVED BEFORE QUANTITY PRODUCTION STARTS

DRAWING SIZE A2

4.7 IW702 Servo Controller Circuit Diagram 043 040 567 Sheet 2.


1
2
3
4
5
6
7
8
9
10
A
B
C
D
E
+5V
R52
330R
U8
CNY75GB
R53
10K
SOD
Q5
BC547B
0V
R54
330R
U9
CNY75GB
I/O[00:13]
R55
10K
I/O13
Q6
BC547B
IGND
+7V
C1
100NF
U10A
74C14
VCC
GND
14
7
R56
680R
R57
680R
C20
100NF
U11
4094B
VDD
STB
DAT
CLK
EN/O
QS
Q'S
VSS
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
ISO01
ISO02
ISO03
ISO04
ISO05
ISO06
U10B
74C14
D18
1N4148
R58
1K
R59
10K
C3
22NF
U10C
74C14
Q9
LM317L
VOUT
VIN
ADJ
C42
100UF/16V
R4
390R
C8
100NF
R5
1K8
C39
100NF
C37
100UF/16V
C7
100NF
R6
390R
R7
1K8
C40
100NF
C43
100UF/16V
C38
100UF/16V
Q10
LM337L
-7V
D28
BAW62
D27
BAW62
D26
BAW62
D25
BAW62
T1
46-46 15-15
C35
10UF/16V
R35
1K
Q11
BC327-25
R34
820R
C36
10UF/16V
R37
1K
Q12
BC327-25
R36
820R
U15C
LM339N
U15B
LM339N
R39
10K
R3
27K
R40
100K
U15D
LM339N
R1
100K
C21
330pF
R47
100K
R2
100K
R38
10K
D24
1N4002
U15A
LM339N
V+
GND
U10D
74C14
U10E
74C14
CW
R60
1K
VR4
10K
C9
47PF
U10F
74C14
UNUSED GATES
U10G
74C14
U1E
74HC02
U15E
LM339N
U12
4053B
VDD
AX
AY
BX
BY
CX
CY
O/IA
O/IB
O/IC
INH
VEE
VSS
A
B
C
R79
10M
C32
47PF
R68
1K
C44
100NF
C31
100NF
SW1
TEST
R26
470R
D22
1N4148
R29
10K
R80
120R
Q7
BC557B
Q8
BC557B
Q15
BC547B
C29
100PF
C30
10PF
D23
1N4148
RL1B
RELAY-PU
D21
1N4148
RL1A
RELAY-PU
VR2
5K
RES00
RES01
RES02
RES[00:07]
U13
4051B
ISO[01:06]
O/IN
38A
38B
R81
120K
1%
R82
56K
1%
R32
1K8
1/2%
R33
4K7
1/2%
A1
A2
A3
R83
22R
1%
R30
4K7
1%
R16
3K9
1/2%
R31
4K7
1%
R69
1K5
1/2%
R70
1K5
1/2%
R71
1K5
1/2%
R72
1K5
1/2%
R73
1K5
1/2%
R74
1K5
1/2%
C33
100NF
C34
100NF
R17
2K2
1/2%
R18
1K5
1/2%
R19
1K
1/2%
R20
1K5
1/2%
P1
ADC-PC834
L1
220UH
L2
220UH
L3
22UH
R62
100K
R63
100K
C22
10NF
U14B
TL074N
R64
10K
C23
470PF
U14D
TL074N
D19
1N4148
R66
10K
C27
47PF
R61
220K
1%
U14C
TL074N
R65
10K
R21
10K
1%
R67
100K
1%
C25
10NF
R28
220R
U16
CNW136
VCC
VE
VO
GND
RST6.5
C28
100NF
Q13
BC547B
R27
10K
C24
100NF
U14A
TL074N
C41
100NF
OVHT
D20
1N4148
U17
CNY75GB
I/O01
C26
100NF
R22
22K
VR3
10K
R23
15K
U14E
TL074N
R24
10K
Q14
BC557B
R25
470R
IGND
-7V
+7V

ISSUE	AUTH. BY	CHG. NO.	DATE	
A	M. YOUNG	0530	1/9/89	ISSUED
B	M. YOUNG	0578	6/7/90	ADDED OVHT, -7V, +7V, IGND TEST POINTS, R79, R80, C44 C9 WAS 10PF. REFER TO SHEET 1.
C	M. YOUNG	0588	3/8/90	ADDED A1, A2, A3, R81, R82 R83 VR4. C9 WAS 33PF. R32, R33 WERE 1% R60 WAS 10K. TITLE WAS "SERVO - CONTROLLER".
C1	M. COLEMAN	0599	15/11/90	SWAPPED A1 & A3 PADS.
D	M. YOUNG	0616	26/3/91	U8, U9, U17 WERE MCT272. U16 WAS 6N137. R28 WAS 560R. REFER TO SHEET 1.
D1	C. WANDER	1461	30/05/93	REDRAWN ON NEW CAD. C21 WAS 100pF.
D2	C. WANDER	1558	08/06/93	R56, R57 WERE M2.

DRAWN
S. SURTEES
CHECKED
APPROVED
7/7/93

MATERIAL:

FINISH:

DESCRIPTION:
IW702 SERVO
CONTROLLER

FISHER & PAYKEL
HEALTHCARE DIVISION
FISHER & PAYKEL ELECTRONICS LTD
25 CARBINE RD, PANMURE.
P.O. BOX 14-348 PANMURE,
AUCKLAND, NEW ZEALAND.
PH (649) 570-5655 FAX (649) 570-9500 TELEX NZ2995

DRAWING NUMBER
043 040 567

SHEET 2
OF 2

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DRAWING SIZE A2

4.8 IW703 Infant Warmer Head Components.

Ref.	Description	Part No.
C1,C14	Capacitor Electrolytic 470µF	999234710
C2,C3	Capacitor Electrolytic 100µF	311040670
C4,C5,C11	Capacitor Mylar 2n7	316040099
C6	Capacitor Ceramic 100nF	312040153
C7,C10,C12, C13,C15	Capacitor Electrolytic 10µF	311040600
C8	Capacitor Ceramic 4n7 230V	312040138
C9	Capacitor Polyethylene 0.33µF 230V	316040553
C16	Capacitor Polyester 0.1µF 250VAC Class X	316040073
D1,D3,D11,D18	Diode 1N4002	361040163
D2	Diode Zener 10V 1W3	361040368
D4,D7,D8	Diode LED Green	361042272
D5,D6,D14,D15, D16,D17	Diode 1N4148	361040155
D9	Diode LED Yellow	999420004
D10	Diode LED Red	999420001
D12	Bridge RB154	361040325
D13	Diode Zener 22V	361040267
D19	Diode Zener 10V	361040210
F1,F2 (for 230V)	Fuse 5 Amp 20×5mm quick acting	348060013
F1,F2 (for 115V)	Fuse 10 Amp 20×5mm	999830011
F3	Fuse 1 Amp 20×5mm	999830001
H1	Thermostat 118°C	349040052
	Thermostat 93°C (Obsolete, see Product History)	349040051
Q1,Q2,Q3,Q4, Q7,Q9	Transistor BC547B	361040159
Q5,Q6	Triac L4008L7	999550011
Q8	Transistor BC337	361040157
R1	Resistor 390E	325042631
R2	Resistor 470K	325040323
R3,R19,R20, R21,R22	Resistor 100K	325040285
R4,R46	Resistor 47K	325040306
R5,R6,R16,R17, R23,R24,R29,R45	Resistor 10K	325040284
R7,R8,R9,R10	Resistor 100K 1%	325040139
R11	Resistor 680E	325040280
R12	Resistor 2K7 1%	325040649
R13,R14	Resistor 2K2 1%	325051379
R15,R37,R39, R43,R44	Resistor 4K7	325040287
R18	Resistor 1M	325052305
R25,R26,R40,R42	Resistor 1K	325040281
R27,R30,R36	Resistor 1K2	325040298
R28,R31	Resistor 820E 5%	325040321
R32	Resistor 22K 1%	325051360
R33	Resistor 27K	325040319
R34	Resistor 1K 2W	324040035
R35	Resistor 220E	325040296
R38	Resistor 150E	325040315
R41	Resistor 82E 1/2W	325041834
R47	Resistor 180E 1/4W	325040309
RL1	Relay	349040096

SP1	Buzzer	426040010
SW1,SW2	Switch	999800055
SW3	Mains Switch	349040068
T1 (for 230V)	Transformer Assembly MR460/480/IW703 230V	043040551
T1 (for 115V)	Transformer Assembly MR460/480/IW703 115V	043040552
U1	IC LM324N	999600002
U2	IC 74C14	999600015
U3	IC 4013	363040011
U4,U5	IC MOC3021	999690001
U6	IC MCT272	363040045
VR1	Potentiometer 5K	327041551

4.9 IW702 Servo Controller Components.

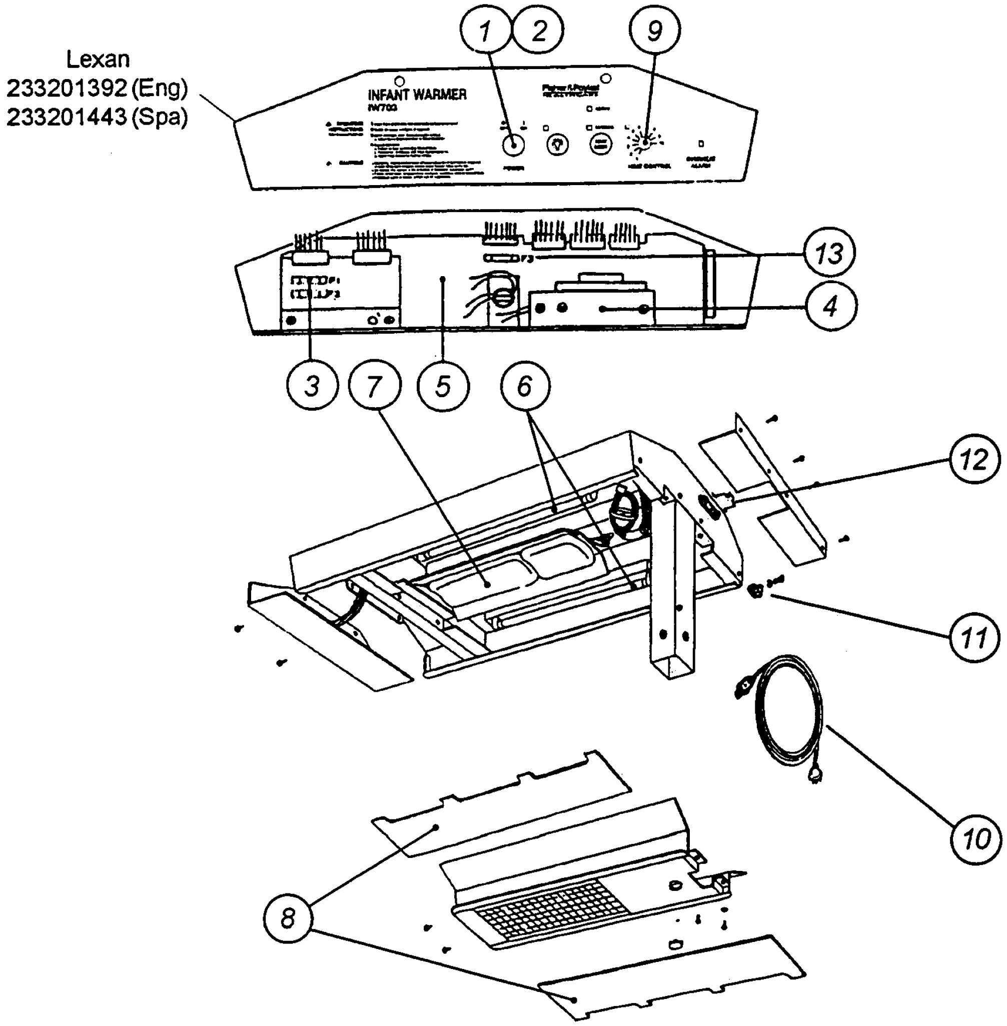
Ref.	Description	Part No.
C1,C4,C5,C6,C7, C8,C15,C16,C18, C19,C20,C24,C28, C31,C33,C34,C39, C40,C41	Capacitor Ceramic 100nF	312040153
C2	Capacitor Ceramic 1nF	999211020
C3	Capacitor Mylar 22nF	999212230
C9,C30	Capacitor Ceramic 10pF	312040178
C10,C11,C12,C35, C36	Capacitor Electrolytic 10μF	311040600
C13,C14	Capacitor Ceramic 22pF	312040130
C17	Capacitor Electrolytic 1000μF	999231020
C21	Capacitor Ceramic 330pF	312040106
C22,C25,C26	Capacitor Mylar 10nF	316040084
C23	Capacitor Ceramic 470pF	312040118
C27,C32	Capacitor Ceramic 47pF	312040179
C29	Capacitor Ceramic 100pF	312040105
C37,C38,C42,C43	Capacitor Electrolytic 100μF	999231010
C44	Capacitor Ceramic 100pF NPO	312040184
D1,D2,D3,D4,D5, D6,D12,D13,D20, D21,D22,D23	Diode 1N4148	361040155
D7,D8	Diode LED Green	361042272
D9,D10,D11,D29	Diode LED Red	999420001
D14,D15,D16,D17, D24,D31	Diode 1N4002	361040163
D25,D26,D27,D28	Diode BAW62	999400004
DSP1-3	LED HDSP5301	999860001
F1	Fuse 1 Amp 20×5mm	999830001
L1,L2	Coil 220μH	999890010
L3	Coil 22μH	999890024
Q1,Q2,Q3,Q5,Q6, Q13,Q15,Q16,Q17	Transistor BC547B	361040159
Q4	IC 7805	999600003
Q7,Q8,Q14	Transistor BC557B	361040156
Q9	IC LM317L	363040303
Q10	IC LM337L	363040304
Q11,Q12	Transistor BC327B	361040158
R1,R2,R40,R47	Resistor 100K	325040285
R3	Resistor 2K2	325040282
R4,R6	Resistor 390E 1%	325040604
R5,R7	Resistor 1K8 1%	325040452

R8,R9,R10,R11, R12,R13,R14,R15	Resistor 27K	325040319
R16	Resistor 3K9 1%	325040489
R17	Resistor 2K2 0.5%	325040655
R18,R20,R69,R70, R71,R72,R73,R74	Resistor 1K5 0.5%	325040137
R19	Resistor 1K 0.5%	325040360
R21	Resistor 8K2 1%	325040352
R22,R51	Resistor 22K	325040318
R23	Resistor 15K 1%	325040142
R24,R27,R29,R38, R39,R41,R44,R45, R46,R53,R55,R59, R60,R64,R65,R66, R75,R76,R78	Resistor 10K	325040284
R25,R26	Resistor 470E	325040278
R28	Resistor 220E	325040296
R30,R31	Resistor 4K7 1%	325040146
R32	Resistor 1K8 0.5%	325048006
R33	Resistor 4K7 0.5%	325040138
R34,R36	Resistor 820E	325040321
R35,R37,R58,R68	Resistor 1K	325040281
R42,R77	Resistor 4K7	325040287
R43,R48	Resistor 12K	325040289
R49	Resistor 6K8	325040335
R50	Resistor 150E	325040315
R52,R54	Resistor 330E	325040310
R56,R57	Resistor 680E	325040280
R61	Resistor 220K 1%	325040126
R62,R63,R67	Resistor 100K 1%	325040139
R79	Resistor 10M	325040320
R80	Resistor 120E	325046034
R81	Resistor 120K 1%	325040179
R82	Resistor 56K 1%	325040685
R83	Resistor 22E 1%	325040133
RL1	Reed Relay	422041514
SPK1	Buzzer	426040010
SW1,SW2	Switch	999800055
T1	Transformer	383040126
U1	IC 74HC02	363040245
U2	IC 74HC132	363040190
U3	IC 8085AH-2	999630012
U4	IC 74HC373	363040216
U5	IC 27CP128 EPROM Programmed Version 2.4	362040066
	IC 27C256 EPROM Programmed Version 2.5	362040072
U6	IC 8156H	999630003
U7	IC MM5451	363040126
U8,U9,U17	IC CNY75GB	363040220
U10	IC 74C14	999600015
U11	IC 4094B	363040219
U12	IC 4053B	999610003
U13	IC 4051B	363040125
U14	IC TL074	363040124
U15	IC LM339	999600014
U16	IC CNW136	363040336
VR1,VR3	Potentiometer 10K	999111031
VR2	Potentiometer 5K	327041551
XTAL1	Crystal 6.14MHz	999820001

5.0 Spare Parts Lists. Grey models

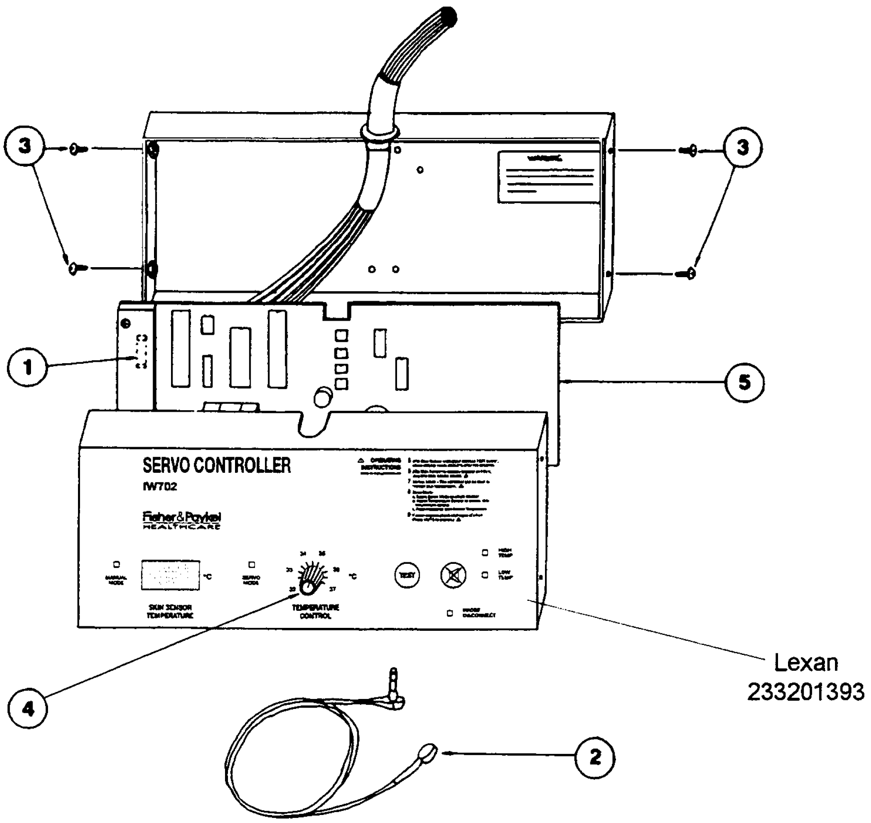
5.1 IW703 Infant Warmer Head - Spare Parts / Exploded Diagram.

Ref.	Description	Part No.
1	Lamp - 14V	424040049
2	Lens Blue	424040042
3	Fuse 5A 20×5mm quick acting (for 230V)	348060013
	Fuse 10A 20×5mm fast acting (for 115V)	999830011
4	Transformer Assembly IW703 230V	043040551
	Transformer Assembly IW703 115V	043040552
5	PCB Assembly IW703 Complete 230V	043040571
	PCB Assembly IW703 Complete 115V	043040610
6	Lamp Fluorescent 18W	424040055
7	Reflector and Heater Assembly 230V	648040089
	Reflector and Heater Assembly 120V	648040100
8	Cover Light	693040380
9	Knob Moulded Control	693040285
10	Mains Power Cord IW703 230V NZ/Aust	095428128
	Mains Power Cord IW703 115V	095428208
	Mains Power Cord IW703 Free (no plug)	095428248
	Plug Mains 3-Pin Clear Top	341040434
11	Cable Grip - P Type	647040117
12	Clip Retainer	625060013
13	Fuse 1A 20×5mm	999830001



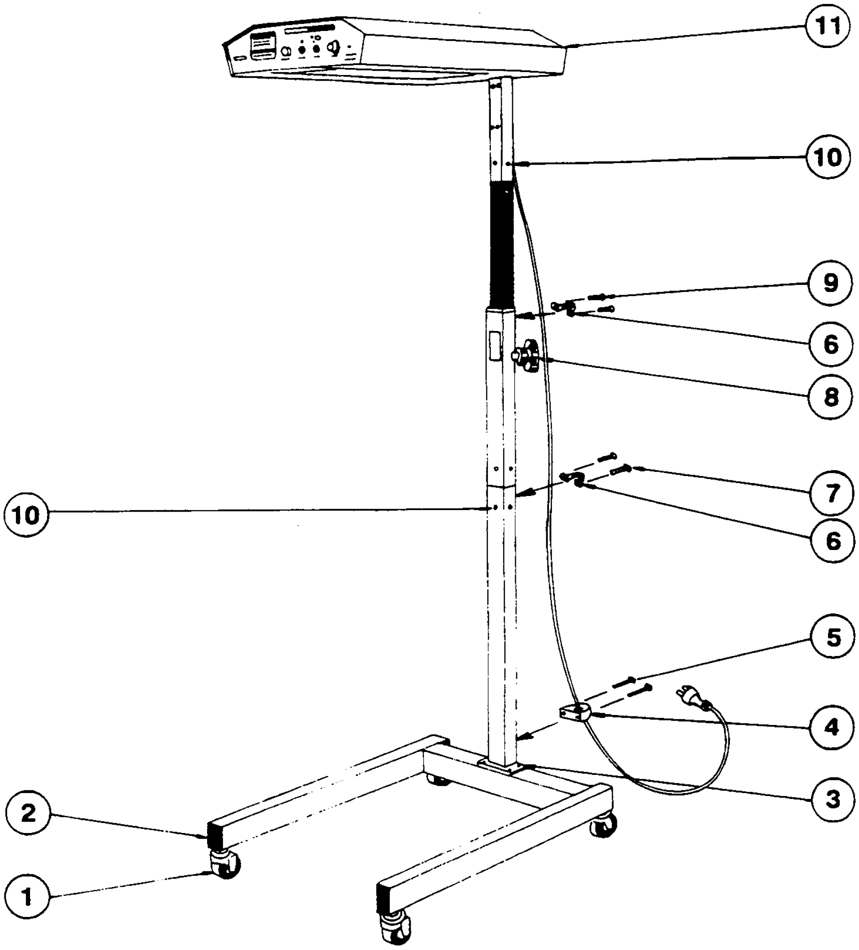
5.2 IW702 Servo Controller - Spare Parts / Exploded Diagram.

Ref.	Description	Part No.
1	Fuse 1A 20×5mm	999830001
2	Skin Sensor Probe	800IW007
3	Screw M6×10 (Allen S/S)	614040254
4	Knob Moulded Control	693040285
5	PCB Assembly IW702AEU Servo Complete	043040846


3
3
1
5
SERVO CONTROLLER
IW702
Fisher&Paykel
HEALTHCARE
SKIN SENSOR TEMPERATURE
TEMPERATURE CONTROL
TEST
Lexan
233201393
4
2

5.3 IW817 Infant Radiant Warmer - Spare Parts / Exploded Diagram.

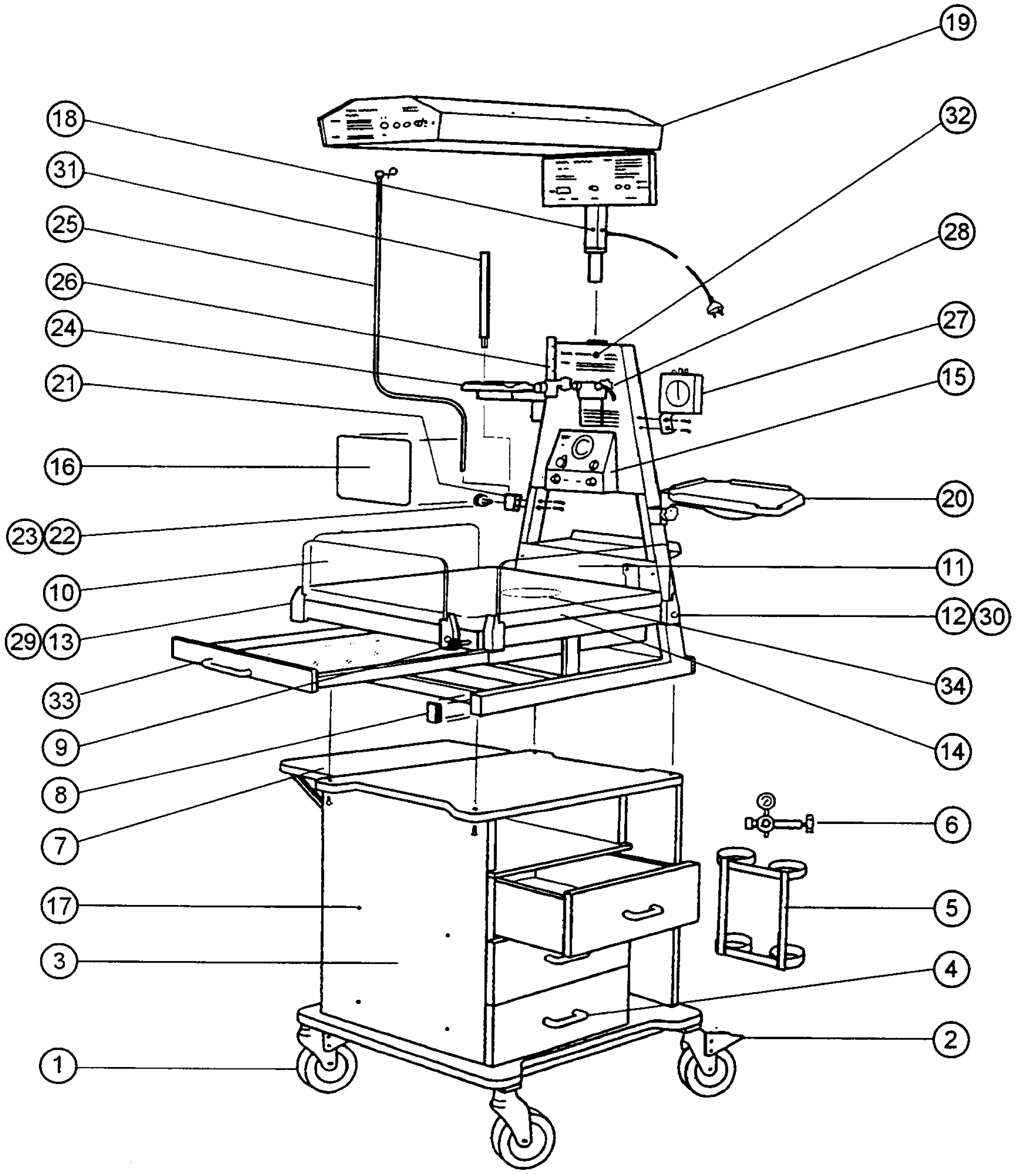
Ref.	Description	Part No.
1	Castor	665040007
2	Plug Rectangular Light Grey	693040615
3	Screw M6×12 (Allen S/S)	614040255
4	Saddle 12mm	647040115
5	Screw M4×25	614040193
6	Saddle S/S	647040114
7	Screw M4×12	614040195
8	Knob Clamp	651040144
9	Screw M4×6	614040194
10	Screw M6×10 (Allen S/S)	614040254
11	Infant Warmer Head	IW703



5.4 IW820 Infant Care Centre - Spare Parts.

Ref.	Description	Part No.
1	Castor - IW820	665040008
2	Castor Lock - IW820	665040009
3	Cabinet	212201010
4	Draw Handle	286040057
5	Cylinder Rack	800IW032
6	Gas Cylinder Regulator	800IW002
7	Side Table	800IW031
8	Plug Rectangular Light Grey	693040615
9	Knob Black	651040150
10	End Cot Hinged	693040592
11	Side Cot Hinged	693040593
12	Hinge Block - Right Hand	693040581
13	Hinge Block - Left Hand	693040580
14	Mattress Pad	800IW004
15	Neopuff Infant Resuscitator	RD1000
16	Plate Cover	648040061
17	Plug 8.5mm Plastic Light Grey	693040616
18	Screw M6×10 Allen (S/S)	614040254
19	Infant Warmer Head	IW703
20	Monitor Shelf Large	800IW039
21	Support Block	800IW033
22	Knob M8 Rossette	651040169
23	Screw M8×10 Allen Black	614040210
24	Shelf Small	800IW040
25	IV Pole	800IW034
26	Flowmeter 0-15 Lpm	800IW001
27	Clock and Bracket	800IW030
28	Suction Unit	800IW005
29	Hinge Block Latch Left	693040582
30	Hinge Block Latch Right	693040583
31	Instrument Mounting Pole	800IW022
32	Oxygen Upgrade Kit English	800IW035
33	X-Ray Tray Upgrade Kit	800IW036
34	Mattress Cover	800IW041

5.5 IW820 Infant Care Centre - Exploded Diagram.


19
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23 22
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12 30
29 13
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33
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14
8
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17
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3
4
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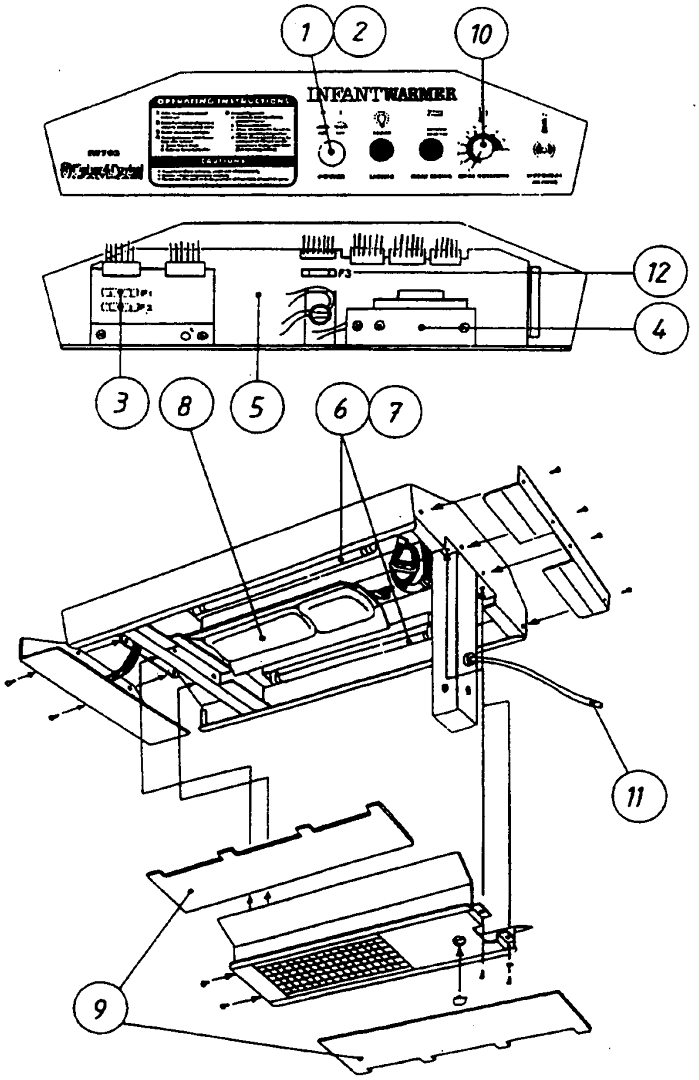
1

6.0 Spare Parts Lists. Blue models

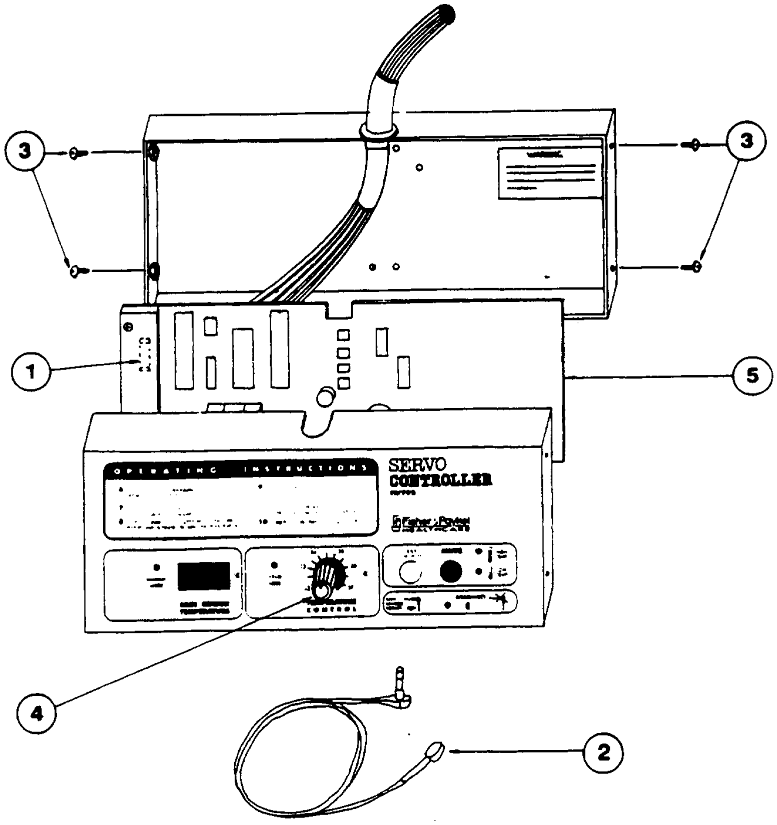
6.1 IW703 Infant Warmer Head - Spare Parts / Exploded Diagram.

Ref.	Description	Part No.
1	Lamp - 14V	424040049
2	Lens Blue	424040042
3	Fuse 5A 20×5mm quick acting (for 230V)	348060013
	Fuse 10A 20×5mm fast acting (for 115V)	999830011
4	Transformer Assembly IW703 230V	043040551
	Transformer Assembly IW703 115V	043040552
5	PCB Assembly IW703 Complete 230V	043040571
	PCB Assembly IW703 Complete 115V	043040610
6	Starter Light 230V 13W	999890022
7	Lamp Fluorescent 18W	424040048
8	Reflector and Heater Assembly 230V	648040067
	Reflector and Heater Assembly 115V	648040099
9	Cover Light	693040380
10	Knob Moulded Control	693040285
11	Power Cord 5m IW817/818/820	095428099
12	Fuse 1A 20×5mm	999830001



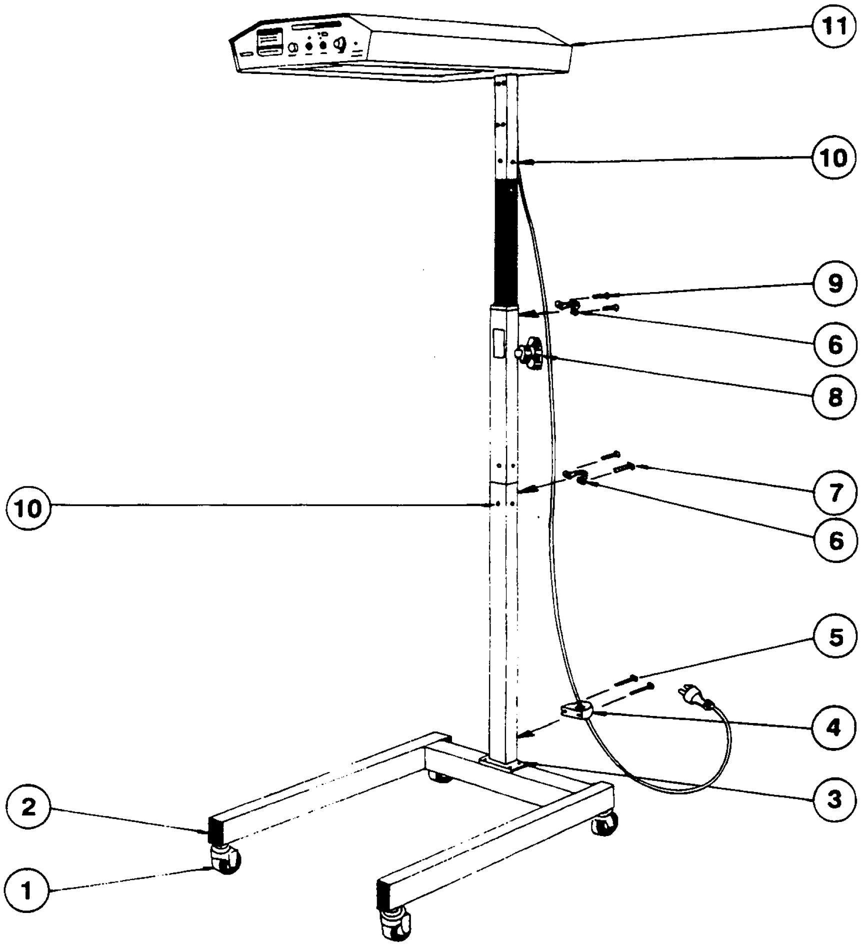
6.2 IW702 Servo Controller - Spare Parts / Exploded Diagram.

Ref.	Description	Part No.
1	Fuse 1A 20×5mm	999830001
2	Skin Sensor Probe	800IW007
3	Screw M6×10 (Allen Black)	614040175
4	Knob Moulded Control	693040285
5	PCB Assembly IW702 Servo Controller Complete	043040567


3
3
1
5
OPERATING INSTRUCTIONS
SERVO
CONTROLLER
CONTROL
4
2

6.3 IW817 Infant Radiant Warmer - Spare Parts / Exploded Diagram.

Ref.	Description	Part No.
1	Castor	665040007
2	Plug Rectangular Black	693040393
3	Screw M6×12	614040188
4	Saddle 12mm	647040115
5	Screw M4×25	614040193
6	Saddle S/S	647040114
7	Screw M4×12	614040195
8	Knob Clamp	651040144
9	Screw M4×6	614040194
10	Screw M6×10 (Allen Black)	614040175
11	Infant Warmer Head	IW703



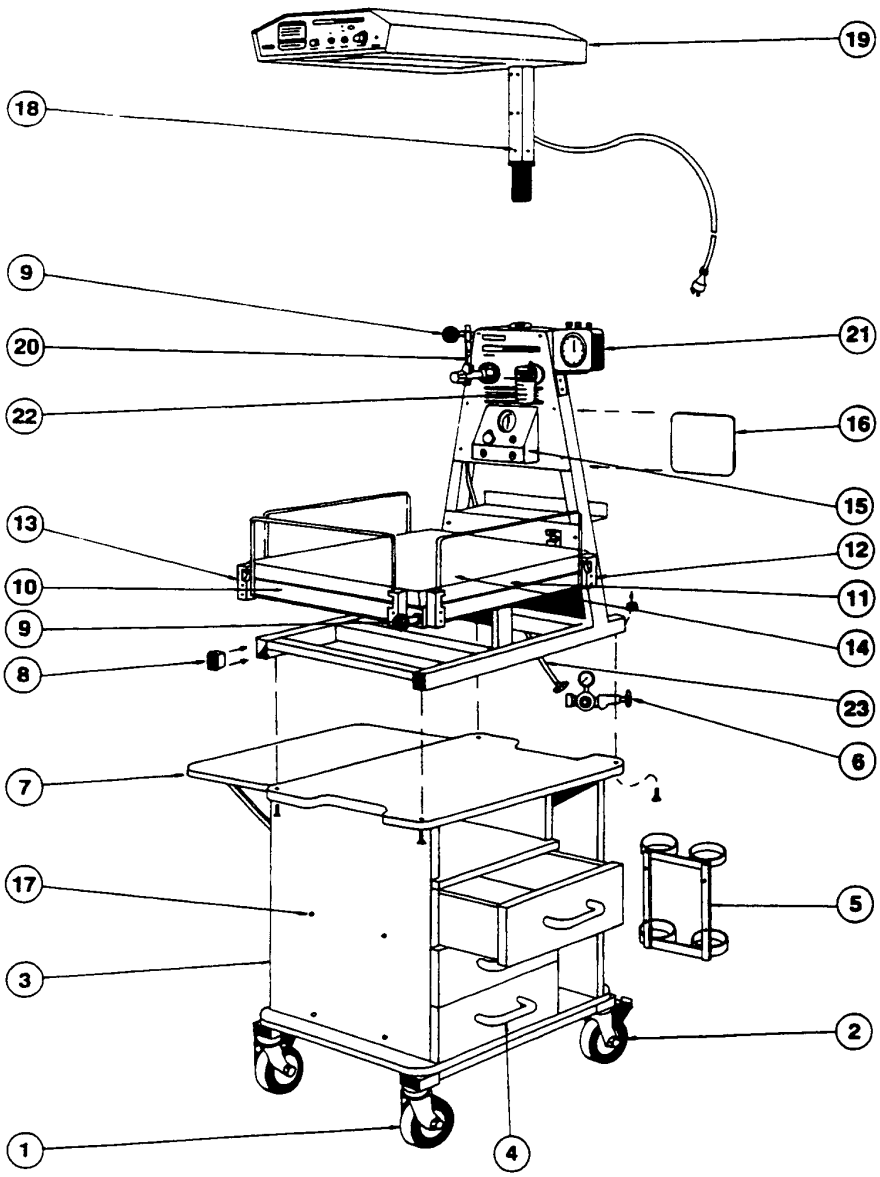
6.4 IW818 Infant Resuscitation Centre - Spare Parts.

Ref.	Description	Part No.
1	Castor - IW818	665040008
2	Castor Lock - IW818	665040009
3	Cabinet	212201004
4	Draw Handle	286040057
5	Cylinder Rack	800IW012
6	Gas Cylinder Regulator	800IW002
7	Side Table	800IW011
8	Plug Rectangular Black	693040393
9	Knob Black	651040150
10	End Cot Hinged	693040465
11	Side Cot Hinged	693040466
12	Hinge Block - Right Hand	693040467
13	Hinge Block - Left Hand	693040468
14	Mattress Pad	800IW004
15	Neopuff Infant Resuscitator	RD1000
16	Plate Cover	648040061
17	Plug 8.5mm Plastic Blue	693040495
18	Screw M6×10 Allen	614040175
19	Infant Warmer Head	IW703
20	Flowmeter 0-15 lpm	800IW001
21	Clock and Bracket	800IW003
22	Suction Unit	800IW005
23	Oxygen Hose Assembly	043040547

6.5 IW820 Infant Intensive Care Centre - Spare Parts.

Ref.	Description	Part No.
1	Castor - IW820	665040008
2	Castor Lock - IW820	665040009
3	Cabinet	212201004
4	Draw Handle	286040057
5	Cylinder Rack	648040058
6	Gas Cylinder Regulator	800IW002
7	Side Table	800IW011
8	Plug Rectangular Black	693040393
9	Knob Black	651040150
10	End Cot Hinged	693040465
11	Side Cot Hinged	693040466
12	Hinge Block - Right Hand	693040467
13	Hinge Block - Left Hand	693040468
14	Mattress Pad	800IW004
15	Neopuff Infant Resuscitator	RD1000
16	Plate Cover	648040061
17	Plug 8.5mm Plastic Blue	693040495
18	Screw M6×10 Allen	614040175
19	Infant Warmer Head	IW703
20	Monitor Shelf	800IW014
21	Support Arm	800IW016
22	Support Block	800IW017
23	Knob M8 Rossette	651040169
24	Screw M8×10 machine	614040210
25	Instrument Tray	800IW015
26	IV Pole	800IW018

6.6 IW818 Infant Resuscitation Centre - Exploded Diagram.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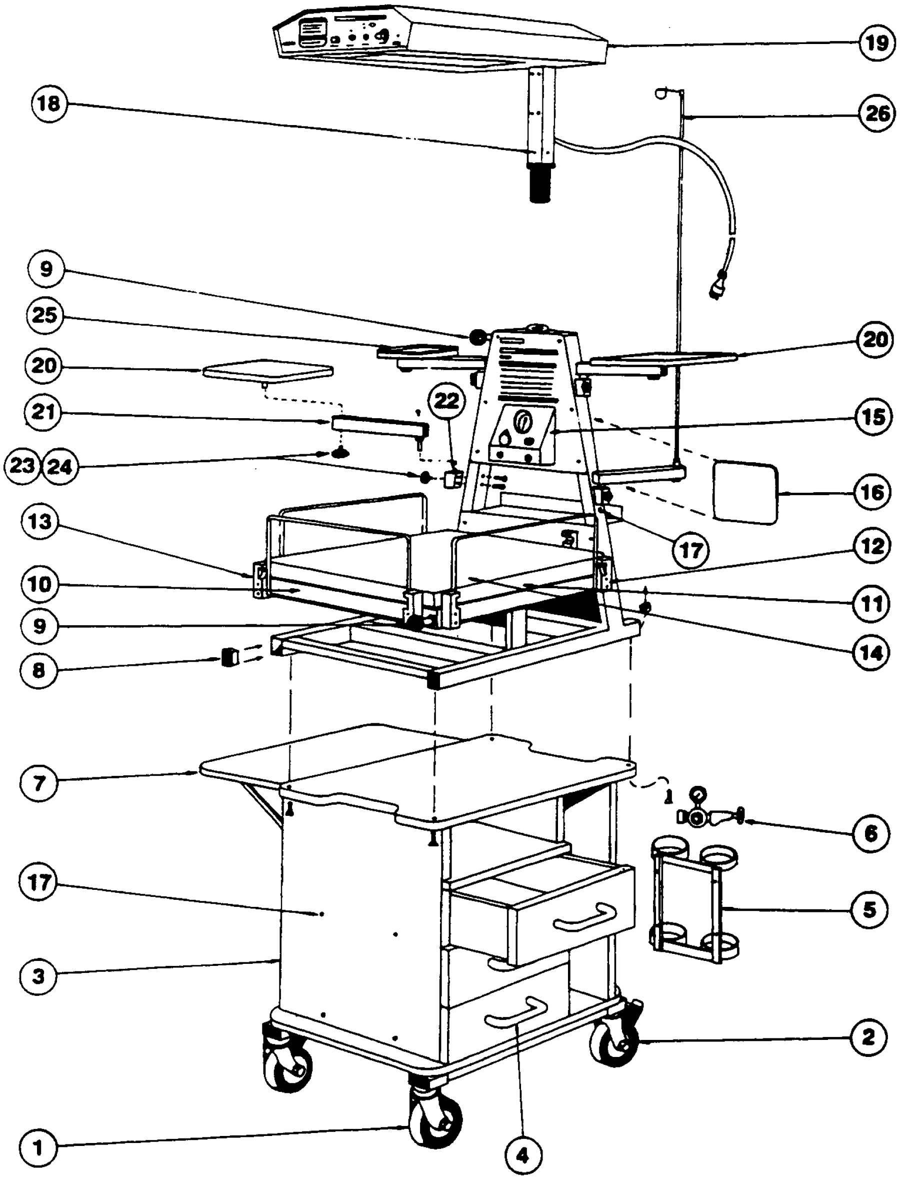
6.7 IW820 Infant Intensive Care Centre - Exploded Diagram.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7.0 Product Change History.

This change history details changes which may have significance for servicing. It does not include all changes. Refer also to change panel on circuit diagrams.

Date	Change Number	First serial number affected	Model	Comments
25/01/91	0608	91LA0001	IW703A	Replaced thermostat 93°C (H1) with thermostat 118°C.
22/04/92	0986	92KA0078	IW702A	Introduction of Version 2.4 Software. Features: Error message 'E32' added to the isolation relay test routine. This error directly indicates incorrect analog 38 °C overtemp calibration. Addition of short audio pulse to indicate successful button latching for IW703 manual/ servo selection buttons. Amendment to Engineering Test Routine during 38 °C Overtemp Calibration and Exit. Amendment to 38 °C Test Routine via Test Button and Exit.
22/09/93	1697	9302AEU00071	IW702AEU	Change colour from blue to grey. Introduction of Version 2.5 Software. Features: Unconditional 15 minute MANUAL mode alarm while in unmonitored MANUAL mode plus 12 minute intermittent warning beep to indicate imminent shutdown. Warm up time in Manual/Servo modes now 15 minutes (was 30 minutes). Optional 30 minute warmup and no unmonitored MANUAL mode alarm via programming port PC1. Addition of error codes for 'stuck' buttons during initialisation. A stuck MUTE button gives 'b-1' and stuck TEST button gives 'b-2'. Amendment to initialisation routine to enable selection of Manual Monitor or Unmonitored Manual mode during the routine.
30/11/93	1807	9303JEU00111	IW703JEU	Resistor R31 changed from 10kΩ to 820Ω.
8/12/93	1824	93LA0182 9303AEA00127	IW703A IW703AEA	Change fuses F1 and F2. Were 5A 125V now 5A 250V.
24/2/94	1895	94LC0001 9303JEU00079	IW703J IW703JEU	Add resistor R47 (180Ω) capacitor C16 (100nF) to IW703 J models only.

7.1 Serial Number Explanation.

8 digit format

YEAR MODEL UNIT NUMBER
\ | /
92 AA XXXX

Model	Country		Volts
LA	IW703A	Australia/Europe	230V
LB	IW703Z	NZ	230V
LC	IW703J	USA	115V
KA	IW702A	Australia/Europe	10V

12 digit format

YEAR MODEL CODE SERIAL NUMBER
\ | | /
93 XX AAA XXXXX

Model Number	Model Type
02	IW702
03	IW703
17	IW817
20	IW820

THREE LETTER CODE

First	Letter	Second	Letter	Third	Letter
	Voltage		Front Panel Language		Customer
A	230V ± 20V	E	English	A	Australasian
J	115V ± 15V			K	as per U but CKD
				U	Universal
				V	Wall Mounted